WiSE® Cardiac Resynchronization Therapy (CRT) System

INSTRUCTIONS FOR USE

Common Section

For use with:

- **WiSE CRT Electrode Catheter (M1000)**
- **WiSE CRT Delivery Sheath (M2000)**
- **WiSE CRT Battery (M3100)**
- **WiSE CRT Transmitter (M4100)**
- **WiSE CRT Programmer (M5100)**

EBR Systems, Inc.
480 Oakmead Parkway
Sunnyvale, CA 94085 USA
www.ebrsystemsinc.com
+1 (408) 720-1906
support@ebrsystemsinc.com

LBL-05300 Rev. 04 Draft

Table of Contents

1 SYSTEM DESCRIPTION

The WiSE CRT System is an implantable, cardiac device capable of pacing the heart without a lead (**Figure 1**). A subcutaneously implanted Transmitter generates ultrasonic pulses that travel to a receiver implanted in the heart. This receiver, also known as the Receiver Electrode or Electrode, converts ultrasonic waves into electrical energy to stimulate cardiac tissue. The WiSE CRT System is not intended to be a life-sustaining device.

The WiSE CRT System applies this leadless technology to stimulate the endocardial surface of the left ventricle (LV). Working in conjunction with a standard commercially available pacemaker (with or without leads) or defibrillator already implanted in the patient, the WiSE System replaces the pacing function of a coronary sinus (CS) lead to achieve cardiac resynchronization therapy (CRT). The WiSE CRT System synchronizes with the co-implant using sensing electrodes in the Transmitter and Battery. As the co-implant paces the right ventricle (RV), the Transmitter generates ultrasound pulses that are received by the Electrode and converted to electrical energy to pace the LV. The sequence of sensing, transmitting, receiving, and stimulating the LV is essentially simultaneous with the co-implanted device's RV pacing output and provides biventricular (BiV) pacing, an operation analogous to standard CRT pacing devices.

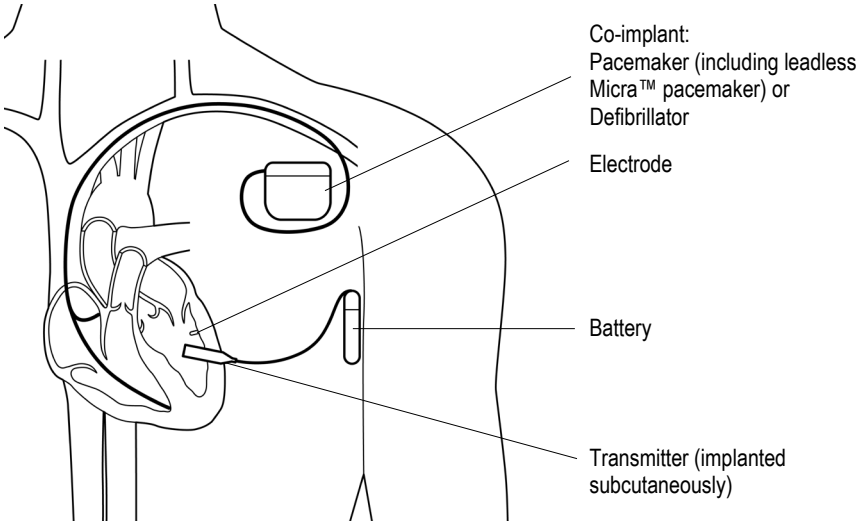


Figure 1**. Implanted WiSE CRT System Components with Co-Implant Device**

The WiSE CRT System has five main components (**Figure 1**):

1. **M1000 (Model 1000) - Electrode Catheter:** A single use catheter used to implant the Electrode, comprising the Electrode and Delivery Catheter (or Electrode Catheter or Catheter). The Electrode is implanted in the LV; it receives ultrasound energy and converts it into electrical energy for endocardial pacing.
2. **M2000 (Model 2000) - Delivery Sheath:** An acute use deflectable guide Sheath used in combination with the M1000 Electrode Catheter.
3. **M3100 (Model 3100) - Battery:** A power source implanted subcutaneously in the mid-axial area of the left thorax, connected to the Transmitter by a cable.

4. **M4100 (Model 4100) - Transmitter:** An ultrasound energy device implanted subcutaneously in the thorax.

The Battery and the Transmitter together may be referred to as Pulse Generator.

5. **M5100 (Model 5100) - Programmer:** An external portable touch screen tablet with a communication module used to adjust parameters on the Pulse Generator and to assist with implant and follow-up of the System.

Note: Read the entire Instructions for Use (IFU) for all components of the WiSE CRT System to understand a complete description of its use.

2 INDICATIONS

The WiSE CRT System is indicated for the following adult patients who are at least 22 years of age, are indicated for cardiac resynchronization therapy (CRT), have an existing or are eligible for an implanted right ventricular pacing system, and are in one of the following two categories:

- Patients in whom previous coronary sinus (CS) lead implantation was unsuccessful, or where an implanted lead has been turned off, referred to as "**previously untreatable**";
- Patients with previously implanted pacemakers or Implantable Cardioverter-Defibrillators (ICDs) in whom standard CRT upgrade is not advisable due to known relative contraindications for CS lead or CRT device implantation, referred to as "**high risk upgrades**".

These categories are defined as follows:

Previously Untreatable:

Patients who have a full or partial CRT system and are deemed as 'previously untreatable' for one of the following reasons:

- CS lead implant was attempted but abandoned due to any of the following: difficult CS access or anatomy, inadequate lead location, inadequate pacing thresholds, phrenic nerve stimulation (PNS), or other procedural challenges;
- Left ventricular (LV) lead that was implanted but not operational includes patients in whom the LV lead is inoperative or programmed off due to improper function such as high threshold, non-capture, PNS, lead failure, lead dislodgement, or suboptimal LV lead location.

High Risk Upgrades:

Patients in whom standard CRT upgrade is not advisable due to known relative contraindication to CS lead implant, for example:

- Risk of venous occlusion or lesion precluding implant (e.g., multiple existing leads in situ);
- Risk of pocket infection at co-implanted device site (e.g., co-implant initial placement or Battery change within last 12 months);

- Considered high risk for CS implant due to co-morbidities (e.g., history of ischemic cardiomyopathy (ICM) or ventricular tachycardia (VT) with risk of epicardial pacing induced VT).

There is insufficient evidence to support the use of the WiSE CRT System in prior CRT non-responders.

The safety and effectiveness of the WiSE CRT System has not been established with leadless pacemaker co-implants that utilize conductive communication (e.g., Abbott Aveir).

3 CONTRAINDICATIONS

The WiSE CRT System is contraindicated for the following:

- Patients on triple anticoagulant who cannot tolerate periprocedural stopping of anticoagulation therapy.
- Patients who cannot tolerate, or are allergic or hypersensitive to, procedural anticoagulation or contrast agents, or to the post-procedural antiplatelet regimen.

4 WARNINGS

- Do not apply therapeutic ultrasound to the WiSE CRT Electrode, Transmitter, or Battery; this can cause untimed electrical stimulation and excessive heating of tissue around and/or damage to implanted components.
- Do not apply diathermy directly over the implanted WiSE CRT System components.
- Do not apply radiofrequency ablation (RFA) close enough to the Electrode to damage the tissue that it is stimulating.
- Do not apply therapeutic radiation over the implanted WiSE CRT System components. Damage to the electronic components of the WiSE CRT System might not be immediately detectable.
- Do not use transcutaneous nerve stimulation (TENS) in close proximity to the WiSE CRT System.

5 PRECAUTIONS

5.1 GENERAL PRECAUTIONS

Do not directly place defibrillation pads over implanted Transmitter or Battery to prevent damage.

5.2 PATIENT PROCEDURE

Based on location and type of a left atrial (LA) or LV thrombus, the physician should determine the patient's suitability for the procedure.

5.3 ELECTRODE IMPLANT LOCATION

Apical LV stimulation in CRT has been shown to be arrhythmogenic. The myocardium is commonly the thinnest at the apex and might be more susceptible to perforation, and apical placement results in shorter distances between the Electrode and apical transthoracic echocardiographic (TTE) views. Hence, apical implant locations are not recommended.

5.4 ULTRASOUND

Be cautious when exposing the patient to sources of ultrasound. This includes the use of imaging devices such as those used in echocardiography. There is a slight potential that the Electrode implanted in the LV of the heart could receive ultrasound pulses and convert them to untimed electrical pacing stimulation. Below are considerations to take prior/ during ultrasound imaging:

- The potential for untimed electrical pacing stimulation is highest in the first 30 days after implant.
- ECG monitoring is recommended during any diagnostic echocardiography in patients with an implanted WiSE CRT System so that inappropriate rhythms can be more readily detected and addressed.
- When performing ultrasound imaging on patients with a WiSE CRT System, a defibrillator should be available in case of emergency.
- In the event of extra pacing stimulation, discontinue imaging and remove probe from patient. If more imaging is necessary consider alternative options such as reducing the power output, a different imaging mode, or adjusting the imaging position.

5.5 PATIENT ENVIRONMENTS

Patients will be provided with a WiSE CRT System Implant Card and Information Booklet that carry similar information. Please remind your patient to:

- Carry the Implant Card at all times, especially during travel and when visiting any medical facility or personnel.
- Review the Information Booklet for important information.
- Avoid or seek medical guidance before entering areas that have signs or are otherwise documented as restricted for persons with implanted pacemakers.

Avoid close proximity and extended exposure to sources of electromagnetic interference. Electromagnetic interference may cause implanted medical devices to inappropriately sense, inhibit therapy, or operate incorrectly. The following are specific sources to be avoided:

- AC and DC motors/ power sources including automobile alternators
- Arc welding equipment
- Large radiofrequency (RF) transmit sources such as radar
- Hand-held radio transmitters (e.g., remote-control devices)
- Electronic article surveillance (anti-theft) devices
- Cell phones and personal music players

  Portable and mobile RF communications equipment can affect medical electrical equipment. Instruct patients to keep cell phones at least 15 cm (6 inches) away from implanted devices by

using the ear opposite the implant side of the body when in conversation. Instruct patients to avoid carrying cell phones or personal music players (e.g., iPod, mp3) in shirt pockets.

5.6 OTHER MEDICAL ENVIRONMENTS

Some devices used in medical environments may damage implanted devices or cause implanted medical devices to inappropriately sense, inhibit therapy, or operate incorrectly; these effects may not be immediately detectable.

General practice during any procedure that has the potential for operational interference is to temporarily turn the WiSE CRT System 'OFF' during the procedure by consulting the WiSE CRT System implanter's office. This will eliminate the possibility of inappropriate sensing and mistimed pacing. Once the procedure is completed, the System will need to be turned back 'ON' and proper device function verified. Instruct medical personnel on this potential for interference. Example of devices and procedures that may interfere with function of the WiSE CRT System include:

- Radiofrequency-based devices used for programming and communicating with other implantable devices such as pacemakers and defibrillators.
- Radiofrequency-based devices used for tissue ablation and/or cauterization.
- Lithotripsy therapy which delivers high intensity ultrasound to dissolve calcific deposits.
- Diathermy, which heats tissue by delivery of high frequency electromagnetic radiation, electric current, or ultrasonic waves.
- Therapeutic ionizing radiation
- Mechanical ventilators.
- Use caution with neurologic stimulation devices that cannot be turned off as they may interfere with the WiSE CRT System. Check with manufacturers for compatibility.

6 POST PROCEDURE CONSIDERATION

Based on physician assessment of individual patient characteristics, including bleeding risk, thromboembolic risk, and patient preference, post-implant antiplatelet therapy may be initiated. For patients prescribed Dual Antiplatelet Therapy (DAPT) alone, a minimum duration of three months is recommended, in accordance with current clinical guidelines and institutional protocols.

7 POTENTIAL ADVERSE EVENTS OR COMPLICATIONS

Potential adverse events relating to interventional procedures or this System may include but not be limited to:

- Access site and pocket complications (e.g., pain, bleeding, infection)
- Air embolism
- Allergic reactions to materials used in the devices, sedatives, other materials and drugs used in the course of implant procedures

- Aortic/ Mitral valve damage
- Arrhythmias
- Breach of Battery or Battery connections
- Cardiac tamponade/ pericardial effusion
- Chronic nerve damage
- Dissection of aorta or branch vessels including femoral artery (includes arterial perforation)
- Early Battery depletion/ malfunction
- Endocarditis
- Electronic or mechanical component failure
- Electrochemical burns
- Embolization of the non-anchored Electrode or other delivery system material
- Excessive bleeding
- Excessive fibrotic growth
- Fluid accumulation in implant pockets
- Foreign body reaction
- General surgery and anesthesia-related risks and complications such as hypotension, hypertension, respiratory failure, syncope, cardiac failure, renal failure, anemia, and death.
- Hypersensitivity to the device materials
- Inappropriate synchronization/ pacing (over-sensing, under-sensing)
- Hematoma at surgical incision, device pocket, or arterial insertion sites
- High rate or competitive ventricular pacing
- Infection and/or sepsis
- Interference from other ultrasound sources that affect System performance or cause the Electrode to pace
- No pacing therapy or no pacing capture leading to worsening heart failure
- Mechanical injury causing tissue damage
- Migration of device that may or may not require surgical revision
- Myocardial infarction
- Myocardial tissue injury or perforation
- Overexposure to X-ray fluoroscopic radiation - Radiation skin burns
- Phrenic nerve stimulation leading to diaphragmatic pacing
- Pneumothorax

- Psychological disturbances (dependency, depression, fear of Battery depletion, fear of malfunction)
- Reset of programmed device parameters
- Skin erosion overlying implanted device
- Septal defect
- Stroke or transient cerebrovascular episodes
- Thermal tissue injury from Transmitter elements
- Thrombus formation and thromboembolism

8 MRI SAFETY INFORMATION

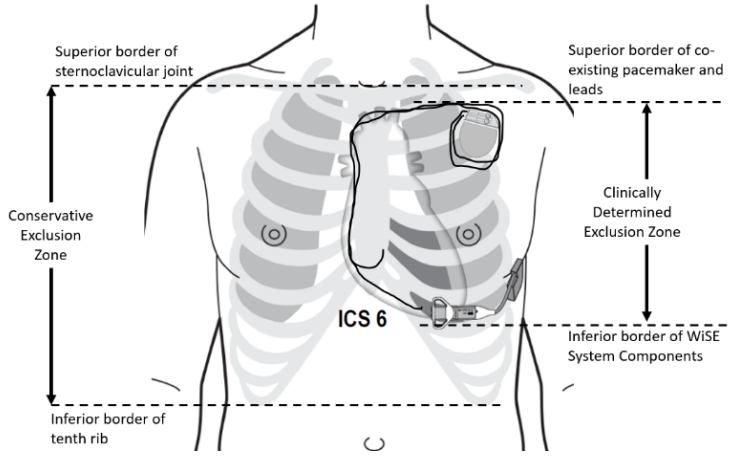
8.1 MR CONDITIONAL

MR Conditional

Non-clinical testing has demonstrated the implanted devices (Electrode, Battery, and Transmitter) of the "WiSE Cardiac Resynchronization Therapy (CRT) System" are MR Conditional. A patient with these implanted devices can be safely scanned in an MR system meeting the following conditions. Failure to follow these conditions may result in injury.

Additional Resources for magnetic resonance imaging (MRI) Safety Information	www.WiSEIFU.com **Phone**: +1 (408) 720-1906 **Email:** techsupport@ebrsystemsinc.com
Parameter	**Conditions of Use**
Device Name	Implanted devices of WiSE CRT System for MR Conditional consisting of: ▪ Receiver Electrode M1000 ▪ Battery M3100 ▪ Transmitter M4100
Static Magnetic Field Strength (B_0)	1.5 Tesla (T), 3 T
Type of Nuclei	Hydrogen
Static Magnetic Field (B_0) Orientation	Horizontal, cylindrical bore

Maximum Spatial Field Gradient	20 T/m (2000 gauss/cm)
Maximum Switched Gradient Slew Rate per Axis	200 mT/m/ms
Maximum Switched Gradient Amplitude per Axis	45 mT/m
RF Polarization (RF Excitation)	Multichannel-2 (MC-2) or circular polarization (CP)
RF Transmit Coil Type	• No local RF transmit coils inside the exclusion zone. • No restrictions on RF transmit coil type when placed outside of the exclusion zone.
RF Receive Coil	Any receive RF coil may be used.
MR System (RF) Operating Mode or Constraints	• 1.5 T: Normal operating mode • 3 T: Normal operating mode
Maximum Whole-Body Specific Absorption Rate (SAR)	2 W/kg (normal operating mode)
Maximum Head SAR	3.2 W/kg (normal operating mode)

Anatomy Scan Region Restrictions	Any scan landmark is acceptable with the exclusion zone placed outside the MR bore.  The exclusion zones are defined as follows: • Conservative Exclusion Zone: It extends from the superior border of the sternoventricular joint to the inferior border of the 10th rib. OR • Clinically Determined Exclusion Zone: It is based on the actual location of the implanted components and determined by palpation of the implanted WiSE CRT

	System and the co-implanted pacemaker system or by X-ray imaging. The conservative exclusion zone must be used if the implanted components cannot be unambiguously identified.
Patient Characteristics	• Scanning patients who have multiple MR Conditional items present is acceptable as long as the MR labeling conditions for all items can be satisfied. • The patient has no broken leads from the co-implanted pacemaker or leads with intermittent electrical contact, as confirmed by lead impedance history.
Patient Position in Scanner	It is mandatory that the MR exclusion zone defined above is observed.
Item Configuration	The following configurations are allowed to enter the MR environment: • A WiSE CRT System with all components implanted • A WiSE CRT System with a subset of components implanted • The implanted WiSE CRT System is implanted with a co-implanted pacemaker system. MR scans are only allowed if the co-implanted pacemaker is also MR Conditional. In addition to the conditions listed above for the implanted WiSE CRT System, all MR scan conditions for the co-implanted MR Conditional pacemaker must be met as well.
Scan Duration	2 W/kg whole-body average SAR for 60 minutes of continuous RF (a sequence or back-to-back series/scan without breaks) in compliance with the exclusion zone
Required Programming Setting	The following programming has to be completed before the patient enters the MR environment: • Implanted WiSE CRT System to OFF-mode **and** • Co-implanted pacemaker MRI Conditional implant mode enabled
Instructions to be Followed Before, During, or After the MRI Exam	The following has to be completed after the patient leaves the MR environment: • The WiSE CRT System and the co-implanted pacemaker programmed to their pre-scan settings. • A system check of the WiSE CRT System and the co-implanted pacemaker to ensure the safe operation.

8.2 EXCLUSION ZONE

Safe scanning of patients with the implanted devices of the WiSE CRT System and the co-implanted pacemaker system requires that both implanted systems are placed outside the MR bore. This is achieved by defining two types of exclusion zones:

- Conservative Exclusion Zone and
- Clinically Determined Exclusion Zone.

The **conservative exclusion zone** covers all possible implant locations of the implanted WiSE CRT System and the co-implanted pacemaker system. It is wider and therefore conservative and can be defined by a physician using easily identifiable anatomical landmarks. The **clinically determined exclusion zone** is narrower, allowing scanning closer to the actual implant locations and thereby expanding the accessible MR scan landmarks for the patient's benefit.

For all scans, the chosen MR exclusion zone (i.e., conservative or clinically determined) for the implanted devices of the WiSE CRT System **must be placed entirely outside** the MR bore.

8.3 WARNINGS FOR MRI SAFETY

Scans must be conducted with the chosen exclusion zone placed entirely outside the MR bore. Placing the exclusion zone inside the MR bore can result in serious and permanent injury including coma, paralysis, or death.

In addition to the scan conditions for the implanted devices of the WiSE CRT System, all scan conditions for the co-implanted MR Conditional pacemaker system must be met.

No local RF transmit coil must be placed over the exclusion zone. The implanted devices of the WiSE CRT System must not be exposed to any RF or gradient fields. Placing a local RF transmit coil over the exclusion zone can result in serious and permanent injury including coma, paralysis, or death.

Discontinue the MRI immediately if the patient becomes unresponsive to questions or experiences any heating, pain, shocking sensations, uncomfortable stimulation, or unusual sensations.

MR scans must be conducted using the stated MRI equipment and scan conditions. Failure to follow all warnings and guidelines related to MRI can result in serious and permanent injury including coma, paralysis, or death.

To ensure the safe operation of the MR Conditional co-implanted pacemaker and the implanted WiSE CRT System perform system check of the implanted devices of the WiSE CRT System and the co-implanted pacemaker after the MR scan.

The Programmer (M5100) has not been evaluated for safety in the MR environment. It has not been tested for heating or unwanted movement in the MR environment. The safety of the Programmer (M5100) in the MR environment is unknown and should not be used in the MR environment. The presence of the Programmer in a MR environment may result in injury or device malfunction.

9 REQUIRED WISE CRT SYSTEM COMPONENTS

Refer to the individual Instructions for Use provided with each WiSE CRT System component for information on their implantation and use (**Table 1**).

Table 1. WiSE CRT System Components Instructions for Use

WiSE CRT System Component	Model Number	Instruction for Use
Receiver Electrode Delivery System	M1000 M2000	LBL-05301
Battery and Transmitter	M3100 M4100	LBL-05302
Programmer	M5100	LBL-05303

10 MEDICAL ALERT BRACELET/ PENDANT

A medical alert bracelet or pendant is an option that is available for patients implanted with the WiSE CRT System to supplement the WiSE CRT System Implant Card and Information Booklet provided to patients. The bracelet/ pendant has an engraved statement that directs the healthcare providers to a website (echo-tips.com) This website provides precautions for potential medical interactions and information to consider when using ultrasound imaging on patients with an implanted WiSE CRT System.

To request the optional medical alert bracelet or pendant, contact EBR at techsupport@ebrsystemsinc.com or +1 (408) 720-1906.

11 SUMMARY OF CLINICAL STUDY

EBR performed a prospective, multi-center, multi-national, pivotal clinical study to establish a reasonable assurance of safety and effectiveness of the WiSE CRT System for the delivery of BiV pacing for CRT in patients with advanced HF. The SOLVE-CRT clinical study was conducted under an Investigational Device Exemption (IDE). The treated population included patients who had previously failed conventional CRT, who had not responded to conventional CRT, or who were high risk upgrades (HRU) for conventional CRT. The study was a global trial including investigational sites from the United States (US), European Union (EU), United Kingdom (UK), and Australia (AU).

11.1 STUDY PURPOSE

The purpose of the SOLVE-CRT clinical study was to demonstrate the safety and effectiveness of the WiSE CRT System.

11.2 STUDY DESIGN

The SOLVE-CRT study was a prospective pivotal clinical trial comprised of three separate, multi-center, multi-country parts:

- Part I Roll-In (n=31), single-arm, open label
- Part II Randomized (n=108), two-arm, randomized 1:1, double-blind
- Part III Single-Arm (n=75), single arm, open label

Part I Roll-In of the study was introduced to provide physicians with implant experiences prior to enrolling patients in the randomized arm of the trial. After enrolling 31 participants, the Roll-In Part was concluded as the results demonstrated low complication rates. Enrollment into Part II Randomized was ongoing was affected by the COVID-19 pandemic and was paused in March 2020 after 108 patients were enrolled at 36 centers. As a result of COVID-19, the trial was modified to include Part III Single-Arm, non-randomized part, to complete the study.

All Part II Randomized participants underwent implantation of the WiSE CRT System which was initially programmed to 'Off. The participants in Part II Randomized were then assigned employing a 1:1 randomization to either the Treatment-Arm ('WiSE On') or Control-Arm ('WiSE Off'). After 6 months of follow up, the Control-Arm patients could cross over to the Treatment-Arm. Part I Roll-In participants and Part III Single-Arm participants were programmed to 'WiSE On' following the procedure. All patients in Parts I, II, and III adhered to the same 6 month follow up schedule.

Participants were followed up for six months after implantation of the WiSE CRT System for primary endpoint analyses. Primary endpoint analyses were from the pivotal parts of the study—Part II (Randomized) and Part III (Single-Arm).

11.3 INCLUSION AND EXCLUSION CRITERIA

11.3.1 Inclusion Criteria

Enrollment in the SOLVE-CRT Clinical study was limited to patients who met the following inclusion criteria:

	Inclusion Criteria
1	Patient with a class I or IIa (1) or (2) indication for implantation of a CRT device according to current available guidelines (with additional QRS criteria on Class IIa (1)):
	a. Class I: New York Heart Association (NYHA) II, III, IV, ejection fraction (EF) ≤ 35%[1], left bundle branch block (LBBB), QRS ≥ 150 ms[2]
	b. Class IIa (1): NYHA II, III, IV, EF ≤ 35%, LBBB, QRS ≥ 130 to < 150 ms
	c. Class IIa (2): NYHA II, III, IV, EF ≤ 35%, non-LBBB, QRS ≥ 150 ms
2	Patient is a:
	a. 'Non-responder' (NR) (Part I and Part II - Roll-In and Randomized Only): [This criterion is not applicable to Part III Single-Arm]: Patients who have a CRT system that is functional and despite an adequate trial of Guideline Directed Medical Therapy (GDMT)[1] and attempts at optimal device programming[2] the patient has not responded to therapy for a minimum of 6 months. Non-response is defined as:

[1] Source documentation should be provided to support non-response despite trial of GDMT which should include an angiotensin converting enzyme inhibitor (ACEI), or angiotensin receptor blocker (ARB), or angiotensin receptor–neprilysin inhibitor (ARNI) in conjunction with evidence-based beta-blocker therapy and aldosterone antagonists, or other cardiac medications (e.g., diuretics, nitrates, digitalis, etc.) that were attempted (Yancy 2013; Yancy 2017). ACEI, ARB or ARNI and beta blocker, aldosterone blockade should be at a stable dose for 30 days. During the 30-day period immediately preceding enrollment, daily dose may increase by no more than 100% from the dose at the beginning of the 30-day stability period and may decrease by no more than 50% from the dose at the beginning of the 30-day stability period.

[2] Attempts at programming for high percentage of BiV pacing and optimization of timing intervals should have been attempted and must be documented.

	Inclusion Criteria
	i. Ejection fraction has remained unchanged or worsened (defined as < 5% increase since implant), **and**
	ii. The patient's clinical status based on the totality of available clinical evidence (such as NYHA class, exercise tolerance, quality of life (QOL), or global assessment) has remained unchanged or worsened, as determined by the local Site Enrollment Committee.
	b. 'Previously Untreatable' (PU) (Part I, Part II, and Part III- Roll-In, Randomized, and Single-Arm): Patients who have a full or partial CRT system, who meet general inclusion criteria, and are deemed as 'previously untreatable' for one of the following reasons:
	i. Patients in whom CS lead implantation for CRT has failed.
	Coronary sinus lead implant was attempted but abandoned due any of the following: difficult CS access or anatomy, inadequate lead location, inadequate pacing thresholds, persistent phrenic nerve pacing, or other procedural challenges.
	ii. CS lead implanted but has been programmed OFF[1].
	Left ventricular lead that was implanted but not operational includes patients in whom the LV lead is inoperative or programmed 'Off' due to improper function such as high threshold, non-capture, phrenic nerve pacing, lead failure, lead dislodgement, or suboptimal LV lead location
	c. 'High Risk Upgrade' (HRU) (Part I, Part II, and Part III): Patients in whom standard CRT upgrade is not advisable due to known relative contraindication to CS lead implant, for example:
	i. Risk of venous occlusion or lesion precluding implant (e.g., multiple existing leads in situ)
	ii. Risk of pocket infection at co-implanted device site (e.g., co-implant placement or battery change within last 12 months)
	iii. Considered high risk for CS implant due to co-morbidities (e.g., history of ICM or VT with risk of epicardial pacing induced VT)
3	Patients on a stable GDMT.
4	Patient must be 18 years old or over.
5	Patient has signed and dated informed consent.
6	Patient has suitable anatomy for implant of the WiSE CRT System (e.g., adequate acoustic window, LV wall thickness in target implant area ≥ 5 mm, absence of LV wall structural abnormalities which may preclude implant).

11.3.2 Exclusion Criteria

Patients were excluded from the SOLVE-CRT study if they met any of the exclusion criteria in the table below.

	Exclusion Criteria
1	Pure RBBB
2	LVEDD ≥ 8cm
3	Non-ambulatory or unstable NYHA class IV
4	Contraindication to heparin, chronic anticoagulants, or antiplatelet agents
5	Triple anticoagulant patients who cannot tolerate periprocedural stopping of anticoagulation therapy
6	Attempted device implant (pacemaker, implantable cardioverter defibrillator (ICD), CRT, LV lead) or successful co-implant within prior 30 days.
7	Patients with planned or expected lithotripsy treatment post implant
8	Life expectancy of < 12 months
9	Chronic hemodialysis
10	Stage 4 or 5 renal dysfunction defined as eGFR < 30
11	Grade 4 mitral valve regurgitation
12	Noncardiac implanted electrical stimulation therapy devices
13	Patients with a prosthetic aortic valve and a non-viable transseptal approach for the electrode implant
14	Patients with a prosthetic mitral valve and a non-viable retrograde aortic approach for the electrode implant
15	Unstable angina, acute myocardial infarction (MI), coronary artery bypass surgery (CABG), or percutaneous transluminal coronary angioplasty (PTCA) within the past 1 month
16	Correctable valvular disease that is the primary cause of HF
17	Recent cerebrovascular accident (CVA) or transient ischemic attack (TIA) (within the previous 3 months)
18	Patients with a history of paroxysmal or persistent atrial fibrillation (AF)/ flutter are excluded if they have had a documented AF episode > 30 min or a cardioversion in the past 30 days from screening.
19	Patients with permanent AF are excluded if they have intact atrioventricular (AV) node conduction (RV pacing < 95%)
20	Already included in another clinical study that could confound the results of this study
21	Pregnancy
22	Known drug or alcohol addiction or abuse
23	Moderate or severe aortic stenosis

	Exclusion Criteria
24	Participant unable to attend follow-up at the investigative center or unable, for physical or mental reasons, or to comply with the trial's procedures
25	For Part II Randomized patients, those who will not tolerate being randomized to the Control Group for 6 months

11.4 STUDY ENDPOINTS

Per the Clinical Investigation Plan, the study was considered a success when both the primary safety endpoint and the primary effectiveness endpoint were achieved.

11.4.1 Primary Safety Endpoint (Part II and Part III)

The primary Safety endpoint for the SOLVE-CRT study was freedom from Type I complications at 6 months post implant compared to a performance goal of 70% for all participants in Part II and Part III of the study (n=183). Type I complications included AEs caused by any component of the investigational system or specific procedure-related events.

11.4.2 Primary Effectiveness Endpoint (PU-HRU of Part II and Part III):

The primary Effectiveness endpoint for the SOLVE-CRT study was the mean relative (%) change in left ventricular end systolic volume (LVESV) as assessed by echocardiography at 6 months post implant compared to a performance goal of -9.3%. All echocardiograms were evaluated by a blinded echocardiographic core lab.

11.5 SUBJECT ACCOUNTABILITY AND DEMOGRAPHICS

11.5.1 Subject Accountability

The first subject was enrolled and the first implant with the WiSE CRT System occurred on January 17, 2018. The last subject completed the 6-month follow-up visit on February 9, 2023. The study database was frozen for analysis on February 15, 2023, and included 214 subjects enrolled. There were 68 investigational sites. **Figure 2** displays the disposition of all 214 enrolled subjects.

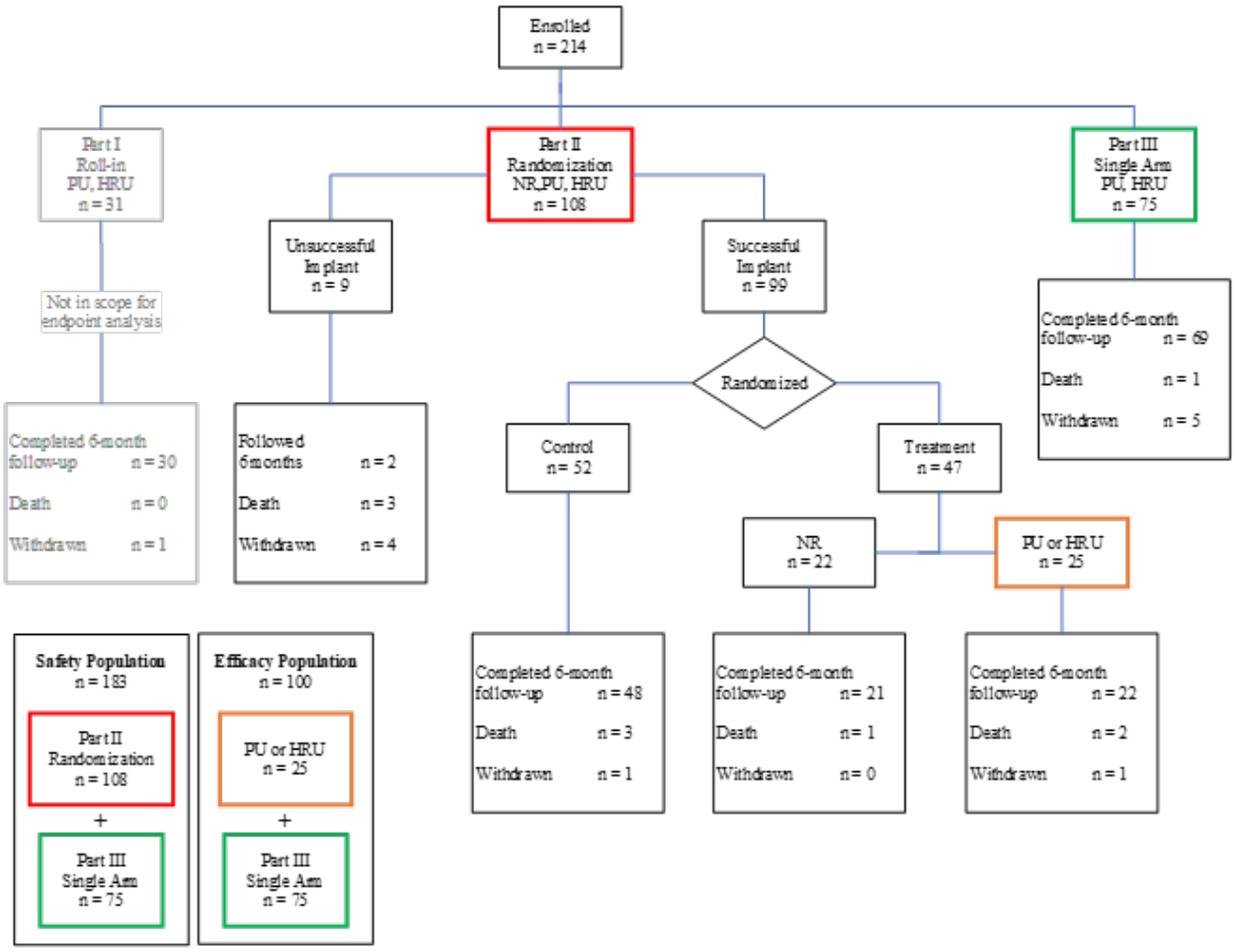


Figure 2. Patient Disposition and Analysis Groups

11.5.2 Subject Demographics and Baseline Parameters

Baseline CRT Indication

All participants in the SOLVE-CRT study met standard indications for CRT therapy. Indication classes were defined as:

- Class I: NYHA II, III, IV, EF ≤ 35%, LBBB, QRS ≥ 150 ms
- Class IIa(1): NYHA II, III, IV, EF ≤ 35%, LBBB, QRS ≥ 130 to < 150 ms
- Class IIa(2): NYHA II, III, IV, EF ≤ 35%, non-LBBB, QRS ≥ 150 ms

As shown in **Table 2** indications for CRT in the Safety population were Class I (68.9%), Class IIa(1) (13.7%), and Class IIa(2) (17.5%). Twenty-four percent (24%) of participants in the Safety population were Non-Responders (NR)s, 60.1% were PUs, and 15.8% were HRUs.

For the Effectiveness population, indications for CRT were Class I (64.0%), Class IIa(1) (14.0%), and Class IIa(2) (22.0%). Seventy-five percent (75.0%) of participants in the Effectiveness population were PUs and 25.0% were HRUs.

The NYHA assessment in the SOLVE-CRT trial was performed by a heart specialist who was either the Principal Investigator or the Sub-Investigator of the Study.

Table 2. Indications for CRT

Indication	Safety Population (N=183) n/N (%)	Effectiveness Population (N=100) n/N (%)
Class I	126/183 (68.9%)	64/100 (64.0%)
Class IIa(1)	25/183 (13.7%)	14/100 (14.0%)
Class IIa(2)	32/183 (17.5%)	22/100 (22.0%)
Non-Responder	44/183 (24.0%)	0/100 (0.0%)
Previously Untreatable	110/183 (60.1%)	75/100 (75.0%)
Failed CS lead implant	68/183 (37.2%)	48/100 (48.0%)
CS lead turned off	42/183 (23.0%)	27/100 (27.0%)
High Risk Upgrade	29/183 (15.8%)	25/100 (25.0%)

Baseline Demographics & Medical History

Table 3 summarizes the baseline demographics and medical history of participants in the SOLVE-CRT study. Overall, there were no significant differences in demographics or medical history between the Safety and Effectiveness populations.

The mean age in the Safety population was 68.1 ± 10.28 years and 68.2 ± 10.47 years in the Effectiveness population, with 66.7% and 67.0% over 65 years of age, respectively. Most patients were male (77.0% in the Safety population and 76.0% in the Effectiveness population) and white (85.8% in the Safety population and 82.0% in the Effectiveness population).

Most had NYHA class III symptoms (65.4% Safety, 65.0% Effectiveness). In addition, about half of the participants in each population had a history of atrial tachyarrhythmia and non-ischemic cardiomyopathy, and about one-third in each population had a history of VT. Study participants in both populations had histories of coronary artery disease, cerebrovascular disease, renal dysfunction, pulmonary disorder, or other medical conditions. These characteristics of the study population are consistent with advanced HF with multiple comorbidities and a poor prognosis.

Table 3. Baseline Demographics and Medical History

Variable	Safety Population (N=183)	Effectiveness Population (N=100)
	Mean ± SD (N) (Min-Max) or n/N (%)	Mean ± SD (N) (Min-Max) or n/N (%)
Age (Years)	68.1 ± 10.28 (183) (32 – 88)	68.2 ± 10.47 (100) (36 – 88)
Age ≥65 Years	122/183 (66.7%)	67/100 (67.0%)
Male	141/183 (77.0%)	76/100 (76.0%)
Body Mass Index (BMI) (kg/m^2)	30.8 ± 5.75 (183) (19 – 51)	30.6 ± 5.45 (100) (19 – 50)
Systolic Blood Pressure (SBP) (mmHg)	119.2 ± 18.69 (183) (79 – 200)	117.5 ± 17.68 (100) (79 – 180)
Diastolic Blood Pressure (DBP) (mmHg)	70.3 ± 10.58 (183) (44 – 100)	69.5 ± 10.45 (100) (44 – 94)
Heart Rate (HR) (bpm)	70.0 ± 10.59 (183) (50 – 100)	70.4 ± 10.25 (100) (50 – 100)
Ethnicity		
Hispanic	7/183 (3.8%)	6/100 (6.0%)
Not Hispanic	170/183 (92.9%)	94/100 (94.0%)
Choose not to answer	6/183 (3.3%)	0/100 (0.0%)
Race		
American Indian or Alaska Native	1/183 (0.5%)	1/100 (1.0%)
Asian	2/183 (1.1%)	2/100 (2.0%)
Black	12/183 (6.6%)	10/100 (10.0%)
Native Hawaiian or Other Pacific Islander	1/183 (0.5%)	1/100 (1.0%)
White	157/183 (85.8%)	82/100 (82.0%)
Chose not to answer	10/183 (5.5%)	4/100 (4.0%)
NYHA		
Class I	0/182 (0.0%)	0/100 (0.0%)
Class II	63/182 (34.6%)	35/100 (35.0%)
Class III	119/182 (65.4%)	65/100 (65.0%)
Class IV	0/182 (0.0%)	0/100 (0.0%)
Rhythm Disorders		

Variable	Safety Population (N=183)	Effectiveness Population (N=100)
	Mean ± SD (N) (Min-Max) or n/N (%)	**Mean ± SD (N) (Min-Max) or n/N (%)**
History of atrial tachyarrhythmia	*92/183 (50.3%)*	*52/100 (52.0%)*
Supraventricular tachycardia	74/183 (40.4%)	46/100 (46.0%)
Atrial fibrillation	19/183 (10.4%)	5/100 (5.0%)
Persistent	3/183 (1.6%)	1/100 (1.0%)
Permanent	0/183 (0.0%)	0/100 (0.0%)
Paroxysmal	16/183 (8.7%)	4/100 (4.0%)
Prior cardioversion	6/183 (3.3%)	1/100 (1.0%)
Atrial flutter	8/183 (4.4%)	2/100 (2.0%)
History of ventricular tachyarrhythmia	*67/183 (36.6%)*	*34/100 (34.0%)*
Ventricular tachycardia	61/183 (33.3%)	31/100 (31.0%)
Ventricular fibrillation	18/183 (9.8%)	7/100 (7.0%)
Type of Cardiomyopathy		
Non-ischemic cardiomyopathy	94/183 (51.4%)	50/100 (50.0%)
Ischemic cardiomyopathy	87/183 (47.5%)	50/100 (50.0%)
Non-ischemic + ischemic cardiomyopathy	2/183 (1.1%)	0/100 (0.0%)
Associated Conditions/ Prior Surgeries		
Prior cardiac device implant	*183/183 (100.0%)*	*100/100 (100.0%)*
Pacemaker	28/183 (15.3%)	21/100 (21.0%)
ICD	69/183 (37.7%)	48/100 (48.0%)
CRT-P	11/183 (6.0%)	4/100 (4.0%)
CRT-D	124/183 (67.8%)	59/100 (59.0%)
LV lead	109/183 (59.6%)	51/100 (51.0%)
Other	18/183 (9.8%)	16/100 (16.0%)
Coronary artery disease history	*104/183 (56.8%)*	*60/100 (60.0%)*
Prior MI	74/183 (40.4%)	41/100 (41.0%)
Prior PTCA	55/183 (30.1%)	30/100 (30.0%)
Prior CABG	53/183 (29.0%)	30/100 (30.0%)
Unstable angina	6/183 (3.3%)	2/100 (2.0%)

Variable	Safety Population (N=183)	Effectiveness Population (N=100)
	Mean ± SD (N) (Min-Max) or n/N (%)	**Mean ± SD (N) (Min-Max) or n/N (%)**
Cardiac valve surgical history	*19/183 (10.4%)*	*14/100 (14.0%)*
Aortic valve replacement	8/183 (4.4%)	6/100 (6.0%)
Mitral valve repair or replacement	10/183 (5.5%)	7/100 (7.0%)
Other valve replacement	5/183 (2.7%)	5/100 (5.0%)
Cerebrovascular disease history	*28/183 (15.3%)*	*16/100 (16.0%)*
Prior stroke/ CVA	19/183 (10.4%)	11/100 (11.0%)
Prior TIA	10/183 (5.5%)	6/100 (6.0%)
Renal dysfunction history	*51/183 (27.9%)*	*31/100 (31.0%)*
eGFR	64.3 ± 22.20 (174) (25 – 146)	64.3 ± 21.95 (94) (29 – 146)
Pulmonary disorder history	*65/183 (35.5%)*	*38/100 (38.0%)*
Chronic obstructive pulmonary disease	25/183 (13.7%)	11/100 (11.0%)
Current smoker	6/183 (3.3%)	4/100 (4.0%)
Former smoker	56/183 (30.6%)	33/100 (33.0%)
Other conditions	*138/183 (75.4%)*	*74/100 (74.0%)*
Systemic hypertension	99/183 (54.1%)	63/100 (63.0%)
Diabetes	64/183 (35.0%)	31/100 (31.0%)
Insulin dependent	21/183 (11.5%)	8/100 (8.0%)
Non-insulin dependent	43/183 (23.5%)	23/100 (23.0%)
Dyslipidemia	94/183 (51.4%)	50/100 (50.0%)
Hyperthyroidism	5/183 (2.7%)	5/100 (5.0%)
Sleep apnea	43/183 (23.5%)	24/100 (24.0%)
Pulmonary artery hypertension	11/183 (6.0%)	3/100 (3.0%)
Peripheral vascular disease	16/183 (8.7%)	8/100 (8.0%)
Cancer	27/183 (14.8%)	15/100 (15.0%)

Baseline Endpoint Measurements

Baseline measurements for clinical variables used for primary safety and effectiveness endpoints are presented in

Table 4.

In the Safety population, mean LVESV was 151.1 ± 67.21 ml, mean left ventricular end diastolic volume (LVEDV) was 210.4 ± 77.8 ml, and mean left ventricular ejection fraction (LVEF) was 29.8 ± 7.9%.

In the Effectiveness population, mean LVESV was 146.3 ± 71.5 ml, mean LVEDV was 206.8 ± 83.6 ml, and mean LVEF was 31.1 ± 7.9%. Mean intrinsic QRS, paced QRS, Kansas City Cardiomyopathy Questionnaire (KCCQ) score, NT-proBNP level, and Acoustic Pacing Capture Threshold (APCT) are also presented in

Table 4.

The baseline endpoint measures were similar between the two study populations and describe a population of patients with advanced HF.

Table 4. Baseline Endpoint Measurements

Variable	Safety Population (N=183)	Effectiveness Population (N=100)
	Mean ± SD (N) Median (Min-Max) or n/N (%)	Mean ± SD (N) Median (Min-Max) or n/N (%)
Echocardiographic Parameters		
LVESV (ml)	151.1 ± 67.21 (181) 138.0 (31 – 409)	146.3 ± 71.51 (100) 125.5 (31 – 409)
LVEDV (ml)	210.4 ± 77.76 (181) 195.0 (49 – 476)	206.8 ± 83.58 (100) 185.5 (49 – 476)
LVEF (%)	29.8 ± 7.90 (181) 30.1 (9 – 56)	31.1 ± 7.89 (100) 31.0 (14 – 56)
Other		
Intrinsic QRS (ms)	165.7 ± 21.69 (92) 162.0 (122 – 231)	166.1 ± 21.10 (49) 162.0 (134 – 231)
Paced QRS (ms)	182.8 ± 26.59 (138) 179.3 (108 – 257)	184.9 ± 24.72 (82) 182.0 (131 – 246)
KCCQ overall summary score	54.7 ± 22.90 (182) 56.0 (3 – 100)	57.2 ± 21.38 (100) 59.8 (13 – 94)
NT-proBNP (pg/ml)	1626.2 ± 2172.41 (153) 882.0 (49 – 14974)	1761.6 ± 2463.09 (86) 1039.5 (49 – 14974)
Acoustic pacing capture threshold (APCT) (mJ)	0.5 ± 0.86 (110) 0.2 (0 – 6)	0.5 ± 0.57 (87) 0.3 (0 – 3)

Baseline Heart Medications

Table 5 provides details of background medical therapy. Overall, these results reflect contemporary medication usage trends and show that the study population was medically optimized for HF treatment prior to entry into the trial.

Table 5. Baseline Heart Medications for Participants

Medication Type	Safety Population (N=183) n/N (%)	Effectiveness Population (N=100) n/N (%)
ACE or ARB or ARNI	168/183 (91.8%)	93/100 (93.0%)
Angiotensin-Converting Enzyme (ACE) Inhibitor	59/183 (32.2%)	30/100 (30.0%)
Angiotensin Receptor Blocker (ARB)	74/183 (40.4%)	38/100 (38.0%)
Angiotensin Receptor-Neprilysin Inhibitor (ARNI)	68/183 (37.2%)	44/100 (44.0%)
Beta-Blocker	174/183 (95.1%)	94/100 (94.0%)
Aldosterone Antagonist	115/183 (62.8%)	58/100 (58.0%)
Sodium-Glucose Cotransporter-2 (SGLT2) Inhibitor	6/183 (3.3%)	6/100 (6.0%)
Diuretic	145/183 (79.2%)	81/100 (81.0%)
Digitalis	11/183 (6.0%)	6/100 (6.0%)
I_f Channel Inhibitor	4/183 (2.2%)	3/100 (3.0%)
Nitrate	37/183 (20.2%)	20/100 (20.0%)

11.6 RESULTS

The primary safety and effectiveness endpoints were met. Since both the primary effectiveness and safety endpoints met the pre-specified stopping rules for interim analysis, the trial was concluded.

11.6.1 Primary Safety Results

The primary safety analysis was based on all 108 participants from Part II Randomized and 75 participants from Part III Single-Arm of the study for a total of 183 patients in the Safety population available for the 6-month evaluation. The key safety outcomes for this study are presented in **Table 6** and **Table 7.**

Adverse event details are reported in **Table 8** and **Table 9.**

In the Safety population, there was an 80.9% rate (148/183 patients) of freedom from Type I complications with a lower bound of the one-sided 98.8% confidence interval of 73.4%, above the 70% performance goal ($p < 0.001$). Thus, the primary safety endpoint was achieved.

Further, a Kaplan-Meier sensitivity analysis was conducted, showing a freedom from Type I complications of 80.6%, with a lower confidence bound of 72.8%, above the performance goal of 70% which confirmed the success of the primary safety endpoint.

Table 6. Freedom from Type I Complication Rate through 6 Months (Safety Population)

Freedom from Type I Complication Rate (N=183)	Analysis Time Point	Lower Confidence Bound (LCB)	Performance Goal	Study Endpoint Conclusion
80.9%	Interim	73.4%	70%	**MET** ***p < 0.001***

Table 7. Kaplan-Meier Analysis for Freedom from Type I Complication Rate Estimate at 6 Months

Freedom from Type I Complications Kaplan-Meier Rate Estimate (N=183)	LCB	Performance Goal
80.6%	72.8%	70%

11.6.1.1 Adverse Events Summary

Adverse events reported from baseline to 6 months post implant were adjudicated by the Clinical Events Committee (CEC). The key safety outcomes for this study are presented in **Table 8** and **Table 9**Table 8. Both observations and complications were reported.

An observation was defined as an AE that does not result in invasive intervention or can be corrected by simple adjustments.

A complication was defined as an AE that results in injury, or significant or permanent disability and meets any one or more of the following:

1. An event that cannot be treated or resolved by simple adjustments/ treatments and requires invasive intervention, intravenous medication, blood product administration, hospitalization or re-hospitalization after discharge or prolonged hospitalization (> 48 hours) prior to discharge, or any combination thereof
2. A procedure- or device-related pericardial effusion or pseudoaneurysm resulting in a procedure
3. An event that results in significant or permanent loss of device function
4. An event that results in death

Complications were further defined by Type I, II, III, or IV.

- Type I complications were those that were caused by a component of the study device system (the WiSE CRT System Transmitter, Battery, Electrode, Catheter, Sheath, and/or Programmer), or specific procedure-related events including vascular events, stroke, pericardial effusion, and pocket events. Note that failure to implant or a failed implant attempt did not count as a Type I complication unless it was associated with an event that was classified as such.
- Type II complications were other procedure-related events not specifically caused by a component of the study device system, but that would not have occurred in the absence of the study implantation procedure.

- Type III complications were events that were caused by a change in the participant's condition unrelated to the implanted study device system or the implantation procedure.
- Type IV complications were pre-existing medical conditions or conditions that occurred while the participant was not enrolled in the Study.

Table 8 shows CEC-adjudicated AEs that occurred through 6 months post implant in the Safety population of the SOLVE-CRT study. There were no unanticipated adverse device effects (UADEs).

Overall, 177 complications occurred in 86 of 183 participants in the Safety population (47.0%). Of the 86 participants who experienced a complication, 19.1% (35/183) had a Type I, 7.7% (14/183) had a Type II, 12.6% (23/183) had a Type III, and 25.7% (47/183) had a Type IV complication.

Of the 35 participants who experienced a Type I complication, 6.6% had a study device system event, 2.7% had a vascular event, 1.6% had a stroke or other thromboembolic event, 3.8% had a cardiac perforation, and 6.6% had a pocket event. Four (4) cardiac perforations required surgical intervention and three (3) were treated with pericardiocentesis of which two (2) appeared to be related to the transseptal puncture. The cardiac perforations requiring surgical intervention occurred early in the study and prompted some additional safety measures for the implant, including the use of real time echocardiography during the Electrode implant. No LV perforations requiring surgical intervention were observed after the implementation of this mitigation.

In addition, the CEC adjudicated 169 observations in 82 of the 183 participants (44.8%) in the Safety population.

Table 8. Adjudicated AEs with ≤ 6 Months Post Procedure

Adjudicated Adverse Events Categorization	Safety Population (N=183)
	N Patients (% Patients) [N Events]
No Complications of Any Type, N Patients (% Patients)	97 (53.0%)
Complications	***86 (47.0%) [177]***
Type I or II	43 (23.5%) [67]
Type I	***35 (19.1%) [43]***
Study device system event	12 (6.6%) [12]
Vascular event (not caused by closure device)	5 (2.7%) [5]
Stroke and other thromboembolic events (e.g., TIA)	3 (1.6%) [3]
Cardiac perforation	7 (3.8%) [7]
Surgically repaired	4 (2.2%) [4]
Pericardiocentesis	3 (1.6%) [3]
Pocket events	12 (6.6%) [15]
Other	1 (0.5%) [1]

Adjudicated Adverse Events Categorization	Safety Population (N=183)
	N Patients (% Patients) [N Events]
Type II	14 (7.7%) [24]
Type III	23 (12.6%) [32]
Type IV	47 (25.7%) [78]
Observations	82 (44.8%) [169]
UADEs	0 (0%) [0]

Type I Complications by Category

Table 9 shows, the overall device and procedure-related (Type I) complication rate through 6 months was 19.1% (35 patients). Of the 183 participants in the Safety population, 12 (6.6%; 3.4%, 11.2%) experienced a study device system event, including two (2) device migrations, two (2) failures to capture, one (1) device dislocation, one (1) ventricular tachyarrhythmias, one (1) medical device replacement, one (1) device component issue, two (2) device dislodgements, and two (2) device embolizations.

Five (5) participants (2.7%; 0.9%, 6.3%) had vascular events including one (1) retroperitoneal hematoma, one (1) leg ischemia, two (2) groin hematomas, and one (1) iliac artery perforation.

There were also three (3) participants (1.6%; 0.3%, 4.7%) who experienced a stroke or other thromboembolic event.

Further, 12 participants (6.6%; 3.4%, 11.2%) experienced a pocket event, including one (1) fatigue, four (4) hematomas, one (1) pneumothorax, one (1) wound dehiscence, one (1) wound infection, one (1) implant site erosion, one (1) implant site hematoma, one (1) incision site infection, one (1) acute anemia, one (1) device issue, and one (1) implant site pocket infection.

Finally, there were seven (7) participants (3.8%; 1.6%, 7.7%) with cardiac perforations, including three (3) with cardiac tamponade, two (2) with pericardial effusion, one (1) cardiac perforation, and one (1) pulseless electrical activity.

Table 9. Type I Complications through 6 Months by Category

Categorization	Safety Population (N=183)
	N Patients, (% Patients) [N Events], LCB, UCB
Study Device System Event	***12 (6.6%) [12], 3.4%, 11.2%***
Device migration	2 (1.1%) [2], 0.1%, 3.9%
Failure to capture	2 (1.1%) [2], 0.1%, 3.9%
Device dislocation	1 (0.5%) [1], 0.0%, 3.0%
Ventricular tachyarrhythmia	1 (0.5%) [1], 0.0%, 3.0%
Medical device replacement	1 (0.5%) [1], 0.0%, 3.0%

Categorization	Safety Population (N=183)
	N Patients, (% Patients) [N Events], LCB, UCB
Device component issue	1 (0.5%) [1], 0.0%, 3.0%
Device dislodgement	2 (1.1%) [2], 0.1%, 3.9%
Device embolization	2 (1.1%) [2], 0.1%, 3.9%
Vascular Event (not caused by closure device)	***5 (2.7%) [5], 0.9%, 6.3%***
Retroperitoneal hematoma	1 (0.5%) [1], 0.0%, 3.0%
Leg ischemia	1 (0.5%) [1], 0.0%, 3.0%
Groin hematoma	2 (1.1%) [2], 0.1%, 3.9%
Iliac artery perforation	1 (0.5%) [1], 0.0%, 3.0%
Stroke and Other Thromboembolic Events (e.g., TIA)	***3 (1.6%) [3], 0.3%, 4.7%***
Cerebrovascular accident	1 (0.5%) [1], 0.0%, 3.0%
Stroke	1 (0.5%) [1], 0.0%, 3.0%
Ischemic stroke	1 (0.5%) [1], 0.0%, 3.0%
Cardiac Perforation	***7 (3.8%) [7], 1.6%, 7.7%***
Cardiac tamponade	3 (1.6%) [3], 0.3%, 4.7%
Pericardial effusion	2 (1.1%) [2], 0.1%, 3.9%
Cardiac perforation	1 (0.5%) [1], 0.0%, 3.0%
Pulseless electrical activity	1 (0.5%) [1], 0.0%, 3.0%
Pocket Event	***12 (6.6%) [15], 3.4%, 11.2%***
Fatigue	1 (0.5%) [1], 0.0%, 3.0%
Hematoma	4 (2.2%) [4], 0.6%, 5.5%
Pneumothorax	1 (0.5%) [1], 0.0%, 3.0%
Wound dehiscence	2 (1.1%) [2], 0.1%, 3.9%
Wound infection	1 (0.5%) [1], 0.0%, 3.0%
Implant site erosion	1 (0.5%) [1], 0.0%, 3.0%
Implant site hematoma	1 (0.5%) [1], 0.0%, 3.0%
Incision site infection	1 (0.5%) [1], 0.0%, 3.0%
Acute anemia	1 (0.5%) [1], 0.0%, 3.0%
Device issue	1 (0.5%) [1], 0.0%, 3.0%
Implant site pocket infection	1 (0.5%) [1], 0.0%, 3.0%

Categorization	Safety Population (N=183)
	N Patients, (% Patients) [N Events], LCB, UCB
Other	***1 (0.5%) [1], 0.0%, 3.0%***
Anemia postoperative	1 (0.5%) [1], 0.0%, 3.0%
Total	**35 (19.1%) [43], 13.7%, 25.6%**

11.6.2 Primary Effectiveness Results

The effectiveness analysis was based on a total of 100 participants at 6 months post implant, 25 PU-HRU Part II participants randomized to the Treatment-Arm and 75 Part III Single-Arm participants at the 6-month time point. Key effectiveness outcomes are presented in **Table 10**Table 10.

Table 10 shows the absolute and relative changes in LVESV at 6 months post implant in comparison to baseline using imputed data. With imputation, measurements of LVESV were available at baseline and 6 months for 92 of 100 participants (92.0%) in the Effectiveness population. The mean relative change in LVESV among those participants was -16.4 ± 22.50% (95% CI, -21.0% to -11.7%) with an upper confidence bound (UBC) below the -9.3% performance goal ($p = 0.003$), meeting the primary effectiveness endpoint. The absolute change in LVESV was -22.8 ± 36.22 ml (95% CI: -30.3, -15.3) which was also statistically significant ($p < 0.001$).

Table 10. Relative and Absolute Change in LVESV at 6 Months from Baseline (Imputed)

Characteristic	Effectiveness Population (N=100)	95% CI	Study Endpoint Conclusion
Baseline (ml)			
N	100	-----	-----
Mean	146.3	132.1, 160.5	-----
SD	71.51	-----	-----
Median (IQR)	125.5 (95.0, 170.5)	-----	-----
Min, Max	31.0, 409.0	-----	-----
Six Months (ml)			
N	92	-----	-----
Mean	125.4	109.3, 141.5	-----
SD	77.67	-----	-----
Median (IQR)	97.5 (75.0, 158.0)	-----	-----
Min, Max	30.0, 368.4	-----	-----
Absolute Change from Baseline at Six Months (ml)			

Characteristic	Effectiveness Population (N=100)	95% CI	Study Endpoint Conclusion
N	92	-----	-----
Mean	-22.8	-30.3, -15.3	-----
SD	36.22	-----	-----
Median (IQR)	-21.0 (-49.5, 0.0)	-----	-----
Min, Max	-123.0, 67.4	-----	-----
Relative Change from Baseline at Six Months (%)			
N	92	-----	-----
Mean	-16.4	-21.0, -11.7	MET (***p = 0.003***)
SD	22.50	-----	-----
Median (IQR)	-15.4 (-34.2, 0.0)	-----	-----
Min, Max	-64.1, 36.1	-----	-----

The primary effectiveness endpoint was also evaluated in the As Treated and Per Protocol analysis populations, and results were similar to the Effectiveness population; namely, the primary effectiveness endpoint was met in both of these analysis populations.

Data Poolability

Data Poolability was tested for the primary safety endpoint and the primary effectiveness endpoint by three poolability factors: 1) Study Part (Randomized vs Single-Arm), 2) Geography (US, EU, UK, AU), and 3) Study Site. Both primary endpoints passed ($p > 0.05$) poolability testing across all three factors.

11.6.2.1 Secondary Effectiveness Results

Secondary effectiveness endpoints were not formally tested. Proportion of participants or descriptive statistics are summarized.

Key secondary effectiveness outcomes are presented in **Table 11 to Table 15**. Secondary endpoints included KCCQ responders, percent BiV pacing, LVEF responders and APCT.

KCCQ Score

Among the 87 participants with KCCQ scores, 57 (65.5%) had an absolute increase of ≥ 5 points in their KCCQ score.

Table 11: KCCQ Responders from Pre-Implant to 6 months - by Analysis Population

	Proportion of subjects achieving an increase in KCCQ Overall Summary Score of 5 points or greater from pre-implant to 6 months
Analysis Population	**n/N (%)**
Efficacy Population	57/87 (65.5%)
Per Protocol	57/87 (65.5%)
As Treated	57/87 (65.5%)

Percent Biventricular Pacing

Among the 86 participants with BiV pacing data, the mean percent BiV pacing was 93.1 ± 13.0%. These results indicate the WiSE CRT System was able to deliver effective BiV pacing for CRT > 93% of the time in those participants.

Table 12: Mean % Bi-ventricular Pacing at 6 Months - by Analysis Population

	% Bi-ventricular Pacing at 6 Months
Analysis Population	**Mean ± SD (N)**
Efficacy Population	93.1 ± 12.96 (86)
Per Protocol	93.1 ± 12.96 (86)
As Treated	93.1 ± 12.96 (86)

LVEF Responders

Among the 89 participants with available data, 41 (46.1%) had an absolute increase in LVEF ≥ 5%.

Table 13: LVEF Responders from Pre-Implant to 6 months - by Analysis Population

	Proportion of subjects achieving an increase in LVEF of 5% or greater from pre-implant to 6 months
Analysis Population	**(N=100)**
	n/N (%)

	Proportion of subjects achieving an increase in LVEF of 5% or greater from pre-implant to 6 months
Efficacy Population	41/89 (46.1%)
Per Protocol	41/89 (46.1%)
As Treated	41/89 (46.1%)

APCT

The APCT is a measure of the energy needed to deliver a pacing pulse at the capture threshold. Among the 83 participants with available data, 79 (95.2%) achieved an APCT of < 2.9 mJ indicating that in greater than 95% of participants, the WiSE CRT System could be programmed as intended to deliver BiV pacing for CRT.

Table 14: Proportion of Patients with APCT less than 2.9 mJ at 6 months

	Proportion of subjects with APCT less than 2.9 mJ
Analysis Population	**n/N (%)**
Efficacy Population	79/83 (95.2%)
Per Protocol	79/83 (95.2%)
As Treated	79/83 (95.2%)

APCT Stability

Among 75 participants with available data, 61 (81.3%) had a relative increase in APCT from pre-discharge to 6 months that was less than 3x, characterizing the stability of energy usage to maintain pacing through this period.

Table 15: Proportion of patients whose APCT relative increase from pre-discharge to 6 months is less than 3x by Analysis Population

	Proportion of patients whose APCT relative increase from pre-discharge to 6 months is less than 3x
Analysis Population	**n/N (%)**
Efficacy Population	61/75 (81.3%)
Per Protocol	61/75 (81.3%)

	Proportion of patients whose APCT relative increase from pre-discharge to 6 months is less than 3x
Analysis Population	**n/N (%)**
As Treated	61/75 (81.3%)

11.6.3 Subgroup Analyses for Primary Endpoints

Freedom from Type I Complications

A subgroup analysis for freedom from Type I complications through 6 months in the Safety population was conducted (**Table 11**). Due to small sample size only descriptive statistics are provided.

Table 16. Subgroup Analysis of Freedom from Type I Complication Rate through 6 Months (Safety Population)

Variable	Subgroup	N	Freedom from Type I Complication Rate (%)
Overall	Safety population	183	148/183 (80.9%)
Sex	Male	141	119/141 (84.4%)
	Female	42	29/42 (69.0%)
Race	White	157	125/157 (79.6%)
	Black	12	11/12 (91.7%)
	Other	4	4/4 (100.0%)
	Chose not to answer	10	8/10 (80.0%)
Age	≥ 65 years	122	98/122 (80.3%)
	< 65 years	61	50/61 (82.0%)
NYHA Class	Class II	63	51/63 (81.0%)
	Class III/IV	119	96/119 (80.7%)
LVESV at Baseline	≥ 150 mL	79	65/79 (82.3%)
	< 150 mL	102	81/102 (79.4%)
LVEDV at Baseline	≥ 200 mL	87	72/87 (82.8%)
	< 200 mL	94	74/94 (78.7%)

Variable	Subgroup	N	Freedom from Type I Complication Rate (%)
LVEF at Baseline	≥ 30%	97	76/97 (78.4%)
	< 30%	84	70/84 (83.3%)
Peripheral Artery Disease	Yes	16	12/16 (75.0%)
	No	167	136/167 (81.4%)
Chronic Obstructive Pulmonary Disorder	Yes	25	19/25 (76.0%)
	No	158	129/158 (81.6%)
Renal Dysfunction	Yes	51	37/51 (72.5%)
	No	132	111/132 (84.1%)
Atrial Fibrillation	Yes	19	12/19 (63.2%)
	No	164	136/164 (82.9%)
Diabetes	Yes	64	49/64 (76.6%)
	No	119	99/119 (83.2%)
Cancer	Yes	27	21/27 (77.8%)
	No	156	127/156 (81.4%)
Cardiac Valve Surgery	Yes	19	18/19 (94.7%)
	No	164	130/164 (79.3%)
Progression of HF	Device ≥ 3 years	102	85/102 (83.3%)
	Device < 3 years	81	63/81 (77.8%)
Co-Implant	CRT	122	98/122 (80.3%)
	ICD	42	34/42 (81.0%)
	IPG	15	12/15 (80.0%)
Eligibility for SOLVE-CRT	Previously untreatable	110	89/110 (80.9%)
	High risk upgrade	29	23/29 (79.3%)
	Non-responder	44	36/44 (81.8%)
Cardiomyopathy	Ischemic	87	72/87 (82.8%)
	Non-ischemic	94	74/94 (78.7%)
ACE	Yes	59	47/59 (79.7%)
	No	124	101/124 (81.5%)

Variable	Subgroup	N	Freedom from Type I Complication Rate (%)
ARB	Yes	74	63/74 (85.1%)
	No	109	85/109 (78.0%)
ARNI	Yes	68	57/68 (83.8%)
	No	115	91/115 (79.1%)
Beta-Blocker	Yes	174	141/174 (81.0%)
	No	9	7/9 (77.8%)
Mineralocorticoid Receptor Antagonist	Yes	115	97/115 (84.3%)
	No	68	51/68 (75.0%)
SGLT2 Inhibitor	Yes	6	5/6 (83.3%)
	No	177	143/177 (80.8%)
$CHADS_2$ Score	≥ 3	90	68/90 (75.6%)
	< 3	93	80/93 (86.0%)

Relative Change in LVESV

A subgroup analysis for relative change in LVESV was conducted (Table 14). Due to small sample size only descriptive statistics are provided:Table 17. Subgroup Analysis of Relative change in LVESV at 6 Months from Baseline

Variable	Subgroup	N	Mean relative change in LVESV at 6 Months from Baseline
Overall	Effectiveness Population	89	-17.7
Sex	Male	68	-17.0
	Female	21	-20.0
Race	White	72	-21.0
	Black	9	-6.6
	Other	4	6.7
	Chose not to answer	4	-7.7
Age	≥ 65 years	56	-18.9

Variable	Subgroup	N	Mean relative change in LVESV at 6 Months from Baseline
	< 65 years	33	-15.6
NYHA	Class II	33	-16.9
	Class III/IV	56	-18.1
LVESV at Baseline	≥ 150 ml	34	-15.3
	< 150 ml	55	-19.2
LVEDV at Baseline	≥ 200 ml	39	-18.9
	< 200 ml	50	-16.7
LVEF at Baseline	≥ 30%	49	-21.6
	< 30%	40	-12.9
Peripheral Artery Disease	Yes	7	-11.2
	No	82	-18.2
Chronic Obstructive Pulmonary Disorder	Yes	10	-2.6
	No	79	-19.6
Renal dysfunction	Yes	27	-14.8
	No	62	-18.9
Atrial fibrillation	Yes	5	-26.0
	No	84	-17.2
Diabetes	Yes	27	-9.6
	No	62	-21.2
Cancer	Yes	15	-26.4
	No	74	-15.9
Cardiac Valve Surgery	Yes	13	-24.3
	No	76	-16.5
Progression of Heart Failure	Device ≥ 3 years	44	-13.6
	Device < 3 years	45	-21.7
Co-Implant	CRT	48	-17.0
	ICD	32	-18.7

Variable	Subgroup	N	Mean relative change in LVESV at 6 Months from Baseline
	IPG	9	-17.6
Eligibility for SOLVE-CRT	Previously Untreatable	66	-16.6
	High Risk Upgrade	23	-20.9
Cardiomyopathy	Ischemic	45	-12.9
	Non-ischemic	44	-22.6
ACE	Yes	26	-10.2
	No	63	-20.8
ARB	Yes	34	-19.3
	No	55	-16.7
ARNI	Yes	40	-20.2
	No	49	-15.6
Beta-Blocker	Yes	84	-17.5
	No	5	-21.3
Mineralocorticoid Receptor Antagonist	Yes	51	-16.8
	No	38	-18.9
SGLT2 Inhibitor	Yes	5	1.1
	No	84	-18.8

11.7 DEATH EVENT SUMMARY

There have been 10 deaths that occurred prior to 6 months among the 183 enrolled subjects in the Safety population. All deaths have been adjudicated by the Clinical Events Committee (CEC). The 10 deaths were from any cause (5.5%); four of those deaths were from a cardiac cause (2.2%).

11.8 CLINICAL STUDY CONCLUSION

The clinical study results demonstrated the safety and effectiveness of the WiSE CRT System in a population indicated for a CRT.

The primary safety endpoint was met as the freedom from procedure-or device-related (Type I) complications at 6-month post implant were 80.9% (lower boundary of the one-sided 98.8% CI, 73.4%) exceeded the pre-specified performance goal of 70% ($p<0.001$). The primary effectiveness endpoint was met with a 16.4% (95% Confidence Interval [CI], 11.7% to 21.0%) reduction in mean LV end systolic

volume (LVESV), which was statistically significant compared to the -9.3% performance goal (p = 0.003).

The SOLVE-CRT study prospectively evaluated the WiSE CRT System, a novel leadless endocardial CRT system, in patients with a failed standard CRT implant due to lead issues or who could not be upgraded to a standard CRT system due to known relative contraindications. This study showed that leadless ultrasound-based endocardial pacing is feasible, safe, and clinically efficacious with an implant success rate (95.5%), an 80.9% freedom from Type I complications, and a mean reduction of 16.4%.

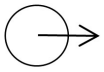
12 SYMBOL GLOSSARY

12.1 SYMBOLS FROM STANDARDS

SYMBOL	STANDARD REFERENCE	STANDARD TITLE	SYMBOL TITLE	EXPLANATORY TEXT
	ISO 15223-1: 2021, Clause 5.1.1	Medical devices — Symbols to be used with medical device labels, labelling and information to be supplied.	Manufacturer	Indicates the medical device manufacture
	ISO 15223-1: 2021, Clause 5.1.3	Medical devices — Symbols to be used with medical device labels, labelling and information to be supplied.	Date of manufacture	Indicates the date when the medical device was manufactured
	ISO 15223-1: 2021, Clause 5.1.4	Medical devices — Symbols to be used with medical device labels, labelling and information to be supplied.	Use-by date	Indicates the date after which the medical device is not to be used
	ISO 15223-1: 2021, Clause 5.1.6	Medical devices — Symbols to be used with medical device labels, labelling and information to be supplied.	Catalogue number	Indicates the manufacturer's catalogue number so that the medical device can be identified

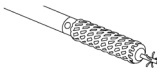
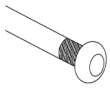
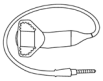
SYMBOL	STANDARD REFERENCE	STANDARD TITLE	SYMBOL TITLE	EXPLANATORY TEXT
	ISO 15223-1: 2021, Clause 5.1.7	Medical devices — Symbols to be used with medical device labels, labelling and information to be supplied.	Serial number	Indicates the manufacture's serial number so that a specific medical device can be identified
	ISO 15223-1: 2021Clause 5.2.11	Medical devices - Symbols to be used with information to be supplied by the manufacturer	Single Sterile Barrier Sterilized using ethylene oxide treatment	Indicates a medical device that has been sterilized using ethylene oxide and has a single sterile barrier
	ISO 15223-1: 2021, Clause 5.2.12	Medical devices - Symbols to be used with information to be supplied by the manufacturer	Double Sterile Barrier Sterilized using ethylene oxide treatment	Indicates a medical device that has been sterilized using ethylene oxide and has a double sterile barrier
	ISO 15223-1: 2021, Clause 5.4.2	Medical devices — Symbols to be used with medical device labels, labelling and information to be supplied.	Do not reuse	Indicates a medical device that is intended for one use, or for use on a single patient during a single procedure
	ISO 15223-1: 2021, Clause 5.2.6	Medical devices — Symbols to be used with medical device labels, labelling and information to be supplied.	Do not resterilize	Indicates a medical device that is not to be resterilized
	IEC 60601-1, Table D.2, Symbol 10	Medical electrical equipment — Part 1: General requirements for basic safety and essential performance.	Follow instructions for use	Refer to instruction manual/booklet.

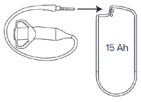
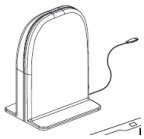
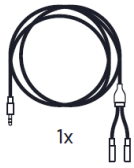
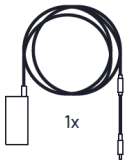
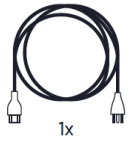
SYMBOL	STANDARD REFERENCE	STANDARD TITLE	SYMBOL TITLE	EXPLANATORY TEXT
	ISO 15223-1: 2021, Clause 4.3	Medical devices - Symbols to be used with information to be supplied by the manufacturer	Consult instructions for use or consult electronic instructions for use.	Refer to electronic format of instruction manual/booklet.
	21 CFR 801.109, Subpart D	Exemptions from Adequate Directions for Use Sec. 801.109 Prescription devices.	Prescription Use Only	Indicates that only professionals licensed by the law of the State in which the practitioner practices to use or order the use of the device can prescribe this device
	ISO 15223-1:2021, Clause 5.2.8	Medical devices — Symbols to be used with medical device labels, labelling and information to be supplied.	Do not use if the package is damaged.	Indicates a medical device that should not be used if the package has been damaged or opened
	ISO 15223-1: 2021, Clause 5.4.4	Medical devices — Symbols to be used with medical device labels, labelling and information to be supplied.	Caution	Indicates the need for the user to consult the instructions for use for important cautionary information such as warnings and precautions that cannot, for a variety of reasons, be presented on the medical device itself
	ISO 15223-1: 2021, Clause 5.3.7	Medical devices — Symbols to be used with medical device labels, labelling and information to be supplied.	Temperature limit	Indicates the temperature limits to which the medical device can be safely exposed
1	ISO 80000-1: 2009 Section 3.1, note 3	Quantities and units — Part 1: General	Quantity	Quantity of package contents

SYMBOL	STANDARD REFERENCE	STANDARD TITLE	SYMBOL TITLE	EXPLANATORY TEXT
	ISO 7000-3079	Graphic symbols for use on equipment	Open here	To identify the location where the package can be opened and to indicate the method of opening it
	IEC 60601-1-2:2020, Clause 5.1.1	Medical electrical equipment — Part 1-2: General requirements for basic safety and essential performance — Collateral standard: Electromagnetic compatibility — Requirements and tests	Non-ionizing electromagnetic radiation	To indicate generally elevated, potentially hazardous, levels of nonionizing radiation, or to indicate equipment or systems e.g., in the medical electrical area that include RF transmitters or that intentionally apply RF electromagnetic energy for diagnosis or treatment
	ISO 27185: 2012 Clause 6.8	Medical devices – Symbols to be used with cardiac rhythm management device labels and information to be supplied	Implantable Device	To indicate an implantable device
	IEC 60417-5035	Graphical symbols for use on equipment.	Output	To identify an output terminal when it is necessary to distinguish between inputs and outputs
	IEC 60417-5031	Graphical symbols for use on equipment.	Direct current	To indicate on the rating plate that the equipment is suitable for direct current only; to identify relevant terminals
	IATA Dangerous Goods Regulations, Section 7.3.18	IATA Dangerous Goods Regulations	Class 9 - Miscellaneous Dangerous Goods	Indicates that the package contains Lithium Metal Batteries Contained in Equipment, Hazard Class UN3091

SYMBOL	STANDARD REFERENCE	STANDARD TITLE	SYMBOL TITLE	EXPLANATORY TEXT
4GV/X11.1/S/** USA/+CG0117	IATA Dangerous Goods Regulations, Section 6.0.4.2	IATA Dangerous Goods Regulations	UN Specification Packaging	The packaging meets UN Packaging Code 4GV`, Performance Level X for Packaging Group I for Gross Mass weight of 11.1 kg, Solids. The year of manufacture and the manufacturer identification are as indicated on the package.
	IEC 60417 - 5009	Graphical symbols for use on equipment.	On/Off (push/push)	To identify power on/off button
	ISO 7000-3650	Graphical symbols for USB connection	USB port/plug	To identify USB port
	Dell	Graphical symbols for use on equipment.	Power Plug	To identify power plug connection
	47 CFR Part 15	Federal Communication Commission Number (FCC ID 2AMRX-5100) (FCC ID 2AMRX-4100)	FCC	Complies with United States Radio communication requirements
	ASTM F2503: 2020	Standard Practice for Marking Medical Devices and Other Items for Safety in the Magnetic Resonance Environment	MR Conditional	To signify that the device is MR conditional and should be used under specific conditions

12.2 SYMBOLS NOT FROM STANDARDS

SYMBOL	REFERENCE	REFERENCE TITLE	SYMBOL TITLE	EXPLANATORY TEXT
	EBR Systems, Inc.	Not Applicable	WiSE CRT System Electrode Catheter M1000	Left ventricular pacing system triggered by co-implant
	EBR Systems, Inc.	Not Applicable	WiSE CRT System Sheath M2000	Left ventricular pacing system implantation sheath
	EBR Systems, Inc.	Not Applicable	WiSE CRT System Battery M3100, 15 Ah	Energy source for the implanted components of the WiSE CRT System
	EBR Systems, Inc.	Not Applicable	WiSE CRT System Transmitter M4100	Left ventricular pacing system triggered by co-implant
	EBR Systems, Inc.	Not Applicable	WiSE CRT System Programmer M5100	External communication instrument used to adjust WiSE CRT System parameters and assist with system implant and follow-up
	EBR Systems, Inc.	Not Applicable	Ultrasound Cardiac Device	Ultrasound is transmitted from the device into the body. The ultrasound is converted by the system to an electrical output in the heart.
	EBR Systems, Inc.	Not Applicable	Inappropriate Battery Connection	Do not connect battery to the heart.
	EBR Systems, Inc.	Not Applicable	Open here	Indicates the location to peel away the sterile barrier.
	EBR Systems, Inc.	Not Applicable	WiSE CRT System Electrode Catheter M1000, Extension Cable	Cable connected between the Electrode Catheter and equipment for electrogram monitoring and pacing
	EBR Systems, Inc.	Not Applicable	WiSE CRT System Electrode Catheter M1000, Reference Needle	Reference needle used as a far field reference and connected to equipment for electrogram monitoring and pacing

SYMBOL	REFERENCE	REFERENCE TITLE	SYMBOL TITLE	EXPLANATORY TEXT
	EBR Systems, Inc.	Not Applicable	WiSE CRT System Delivery Sheath M2000, Syringe	Used to inflate the Delivery Sheath's balloon
	EBR Systems, Inc.	Not Applicable	WiSE CRT System Delivery Sheath M2000, Flush Extension Line	Extension with hub to connect to and to flush
	EBR Systems, Inc.	Not Applicable	WiSE CRT System Delivery Sheath M2000, Pigtail Dilator with Insertion Tool	Used over a guidewire to support access to left ventricle
	EBR Systems, Inc.	Not Applicable	WiSE CRT System Delivery Sheath M3100, Torque Wrench	Torque wrench used to secure connection between Transmitter and Battery
	EBR Systems, Inc.	Not Applicable	Connector Type	Connection between Transmitter and Battery
	EBR Systems, Inc.	Not Applicable	WiSE CRT System Programmer M5100, Radio Input Module (RIO)	Support communication between the Programmer and WiSE CRT System
	EBR Systems, Inc.	Not Applicable	WiSE CRT System Programmer M5100, Recording System Connection Cable	Marker events cable for RIO
	EBR Systems, Inc.	Not Applicable	WiSE CRT System Programmer M5100, AC Power Adapter	AC power adapter
	EBR Systems, Inc.	Not Applicable	WiSE CRT System Programmer M5100, AC Power Adapter United States Power Cord	Power cord for AC Power adapter
	Dell	IEC 60417 - 5009	Lock	Indicates to lock the M5100 tablet

SYMBOL	REFERENCE	REFERENCE TITLE	SYMBOL TITLE	EXPLANATORY TEXT
	Dell	Not Applicable	Graphical symbol for Display Port USB-C port	Indicates a USB-C port can be used for video output
	Dell	Not Applicable	Graphical symbols for SuperSpeed (SS) USB port	Indicates a SS USB port is available. This port is used for the M5100 COM module

WiSE® Cardiac Resynchronization Therapy (CRT) System

INSTRUCTIONS FOR USE

Programmer

Software Release 6.5

For use with:

- **WiSE CRT Programmer (M5100)**
- **WiSE CRT Transmitter (M4100)**
- **WiSE CRT Battery (M3100)**
- **WiSE CRT Electrode Catheter (M1000)**

EBR Systems, Inc.
480 Oakmead Parkway
Sunnyvale, CA 94085 USA
www.ebrsystemsinc.com
+1 (408)-720-1906
support@ebrsystemsinc.com

LBL-05303 Rev. 03 Draft

Table of Contents

1 PRECAUTIONS

For use only by Qualified Medical Personnel in professional healthcare environments: The WiSE CRT System Programmer is intended to be used by qualified physicians and medical technicians. The Programmer is only to be used in professional healthcare facilities. EBR provides training for clinical use of the Programmer. Obtaining this training prior to using the Programmer is the responsibility of the operator. The information provided in these Instructions for Use (IFU) and in the WiSE CRT System Common Section IFU (LBL-05300) should be considered as a required supplement for qualified and experienced medical professionals.

Use only the Programmer M5100 (Model 5100) to attempt to communicate and program the WiSE CRT System.

1.1 STORAGE AND HANDLING

Devices should be stored in their original packages in a dry, clean environment.

1.2 CO-IMPLANTED PACEMAKER AND DEFIBRILLATOR COMPATIBILITY

The WiSE CRT System is intended to be used to provide biventricular (BiV) pacing (BiVP) in conjunction with a co-implanted pacemaker or defibrillator. Program the co-implanted pacemaker or defibrillator to deliver ventricular pacing with the appropriate mode and timing interval settings as would be required for CRT.

1.3 ENVIRONMENTAL INTERFERENCE

- Medical electrical equipment needs special precautions regarding electro-magnetic compatibility (EMC) and needs to be installed and put into service according to the EMC information provided in these Instructions for Use.
- The use of accessories or cables other than those supplied with the Programmer M5100 may result in increased emissions of or decreased immunity to electromagnetic interference.

2 WiSE CRT System Programmer

The WiSE CRT System has programmable parameters and settings that are adjustable in the Transmitter M4100 (Model 4100) using the Programmer M5100. Delivery of CRT relies extensively on the settings of the co-implanted pacemaker or defibrillator for the pacing mode, pacing rate, tracking intervals, etc. The WiSE CRT System depends on sensing the ventricular pacing electrical output of the co-implant and immediately triggering an ultrasonic transmission to activate the Electrode in the left ventricle to provide BiV pacing for CRT. The WiSE CRT System has a minimal set of programmable parameters. These parameters are used to ensure adequate sensing of the ventricular pacing output of the co-implant and to optimize the ultrasound transducer transmission to efficiently use energy from a WiSE CRT Battery.

The Programmer is packaged in a case containing the following:

1. M5100 tablet computer and radio module (RIO)
2. AC power adapter, with country-specific power cord
    - Use only the AC power adapter provided with the Programmer to maintain electrical safety.
    - If it is necessary to isolate the Programmer from the main power, remove the power cord from the external supply module.
3. A recording system connection cable for connecting analog output signals for Marker Events
4. A copy of these Programmer M5100 Instructions for Use and the WiSE CRT System Instructions for Use.
5. The tablet computer contains interfaces and communication protocols, a subset of which are available for the functionality or intended use of the Programmer M5100. **Table 1** provides a list of communication ports on the tablet computer and the RIO along with their function:

Table 1. List of Communication Ports on Table Computer and the RIO

Device	Interface	Description
Tablet	Power connector	The power connector connects to the provided tablet charger that connects to AC power source.
Tablet	USB Type-A	USB port is connected via USB cable to the RIO.
Tablet	USB 3.1 Type-C connector	USB port is available but not necessary for the functionality or intended use of the tablet computer.
Tablet	Micro SD-card slot	Available but not necessary for the functionality or intended use of the tablet computer.
Tablet	Headset connector	Physically inaccessible
Tablet	Docking station adapter	Physically inaccessible
Tablet	Bluetooth	Disabled

Tablet	WiFi	Disabled
RIO	USB Type-A	Refer to **Section 2.1.1**
RIO	Marker Events port	Refer to **Section 2.1.1**

2.1 USING THE PROGRAMMER

The Programmer and Transmitter communicate using a standard radiofrequency protocol referred to as the medical implant communications service (MICS) or MedRadio. This is an ultra-low power radio link that supports transmitting data for diagnostic or therapeutic operation of implantable medical devices. This communication standard has been integrated into the WiSE CRT System.

Communication can be established by the Programmer scanning the immediate vicinity for Transmitters. The Programmer can only establish a connection with WiSE CRT devices. Additionally, no other devices using the MICS protocol can establish communications with the WiSE CRT Programmer.

Note: The Programmer's radio module should be preferably placed on a flat surface with an unobstructed view and within 2 meters (6 feet) of the patient in order to establish sufficient communication signal strength between the Programmer and the Transmitter. Move the radio module closer to the patient to improve signal strength. In some circumstances the radio module may have trouble establishing a link with a Transmitter, change position and orientation of the radio module until a connection is established.

Interference generated by other equipment in the room, or movement of equipment or personnel in the room may cause changes to the radio signal strength resulting in loss of communication between the Programmer and implanted Pulse Generator (i.e., Battery and Transmitter). This is an anticipated occurrence and will not result in any risk to the patient or the implanted Battery or Transmitter. If loss of communication occurs, a message is displayed on the Programmer warning the user that communication with the Pulse Generator has stopped. If this message appears, try to reduce or eliminate the source of interference by turning off or moving interfering equipment, ensuring that there is a clear line of sight from the radio module to the patient, and that the Programmer and patient are within 2 meters. Select RECONNECT on the Programmer to re-establish a communications session with the implanted Pulse Generator.

Note: Position the Programmer tablet computer and radio module such that these are not in direct contact with the patient's skin.

2.1.1 Configuring Connections to the Radio Module and the Tablet Computer

As illustrated in **Figure 1**, the radio module has an integrated USB-based cable for connecting to the tablet computer. The radio module also has a connection for analog outputs for Marker Events and contains two USB ports for the use of memory modules. Reports can be sent directly to the USB memory modules connected to these ports.

The radio module has an LED located above the analog output for the Marker Events. The color of the LED indicates the status of the radio module:

- LED is blue: Radio module is powered on but not engaged in any active transmissions.
- LED is flashing green: The radio module is searching for Transmitters.
- LED is solid green: The radio module is connected to a Transmitter.

- LED is yellow: A fault has been detected with the radio module.
- LED is off: The radio module is not powered on.

Note: Use only a USB flash drive with the radio module. Do not connect any other USB devices to the radio module.

Note: Use only the marker cable supplied by EBR with the Marker Events port. Do not connect any other cables or devices to this port.

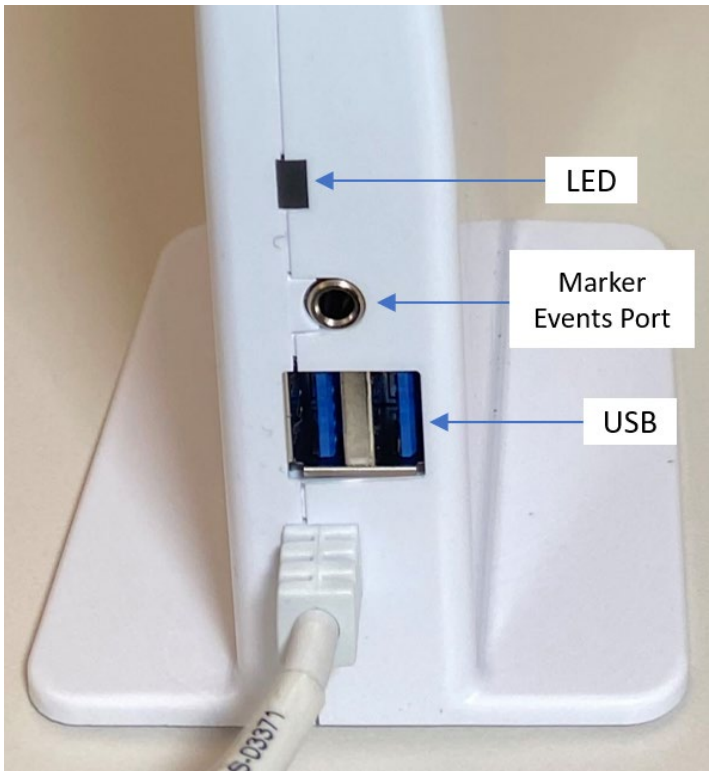


Figure 1. Radio Module Connection Panel
The radio module connections are located on one side of the device.

The tablet computer has a DC input power cable. The cable and the AC power adapter are supplied with the Programmer.

Note: Use only the AC power adapter provided with the Programmer to maintain electrical safety.

Note: The tablet computer is not connected to the network. See **Section 5.5**, Security Information.

2.1.2 Turning the Programmer ON/ OFF

The Programmer's computer tablet is powered from an integrated Battery or by connecting the tablet to AC line power using the DC power supply (AC power line should be the primary power source where available). Ensure that the Programmer is positioned so the power cord is accessible. The radio module is powered from the tablet computer via the USB connection.

The Programmer is powered ON from a switch on the upper right-hand side of the tablet computer. The Programmer is powered OFF/ shutdown using an on-screen selection button (**Figure 3**)).

To turn the Programmer ON, press and hold the power switch until the green light within the power-on switch remains on. As shown in **Figure 2**, the display presents a password login screen where you enter the password to proceed. Contact EBR in the event you need the password.

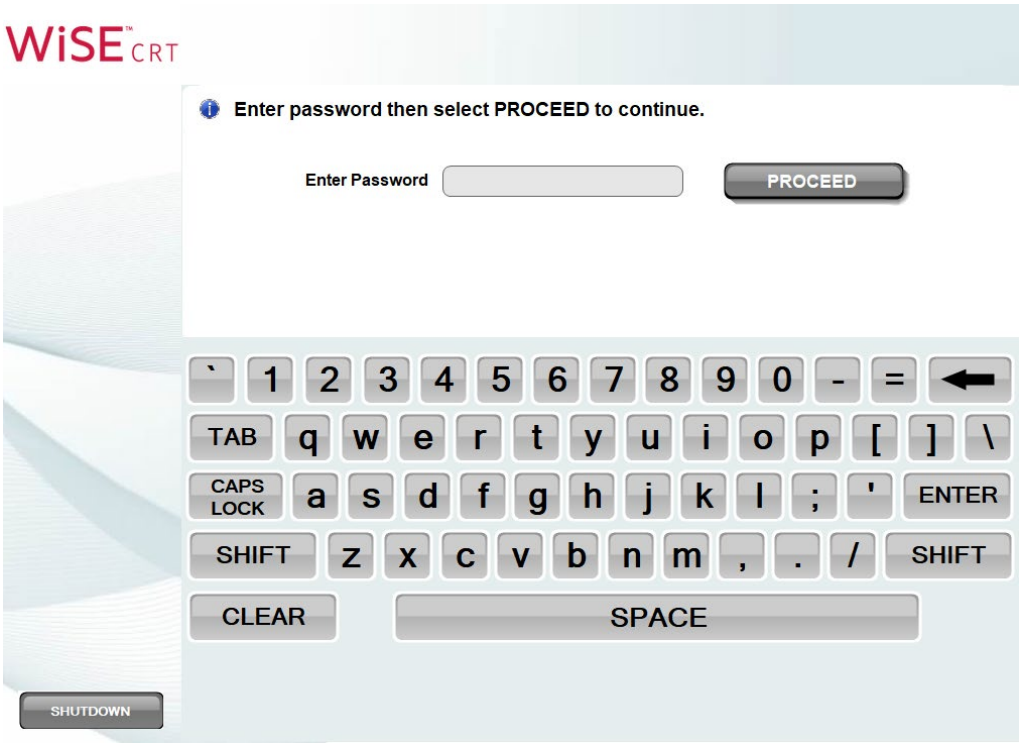


Figure 2. Password Screen

Once the correct password is entered, the start-up process continues, and the display transitions to the CONNECT screen where the tablet computer initiates a radio module scan for WiSE CRT Transmitters.

The Programmer may also be turned OFF using the power switch. Press and hold the switch for at least 6 seconds and then release the switch. The Programmer will then turn off automatically and the green light within the power-on switch will be extinguished.

Figure 3. Programmer Menu Located on the Left Side of the Display Screen

To turn the Programmer OFF, first select the [SHUTDOWN] button on the Main Menu and confirm the shutdown selection in the pop-up dialog box by selecting the [YES] button. The Programmer will then turn off automatically. The power-on indicator will remain illuminated for a short while after the screen darkens. Wait until the indicator is off before pressing the ON switch again.

The Programmer will display a Shutdown Confirmation or Disconnect Confirmation Dialog Box (**Figure 4**). If the Transmitter has been programmed to an OFF or SENSE ONLY mode setting, then this dialog

will notify the operator that the operational setting is not programmed to pace. If the Transmitter has been programmed to the RV Synchronous mode, then the transmit level and pulse width will be shown in the dialog box.

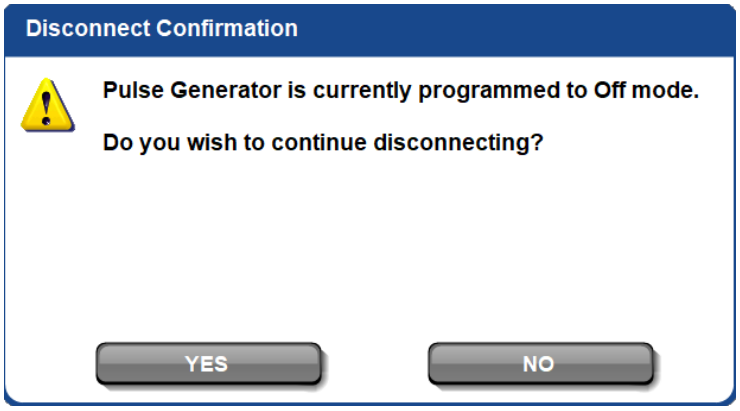


Figure 4. Disconnect Confirmation Dialog Box

2.1.3 Using the Touch Screen for Selection

User selections on the Programmer are made on a touch-screen display. Selectable areas of the screen appear as labeled graphic buttons, icons, scrolling up/ down arrow buttons, selectable list items, or text entry areas.

Buttons, icons, list items, and active screen areas for text entry can be activated by touching the screen with a finger. With each successful button contact an audible sound is produced to further discern the response. A “click” sound indicates the button action has been initiated. A “boop” sound indicates that the button action has not been initiated and an error has occurred in the selection of the button.

Buttons that indicate the current active selection are highlighted in blue. Buttons are selectable (active) if they are highlighted in dark gray. Buttons are not selectable if they are shown in light gray. The [PROGRAM] button is an exception when it is active; it is always displayed in an orange color. On-screen values that are displayed in blue or orange are transferred to the Transmitter when the [PROGRAM] button is selected.

2.1.4 Navigating with the Main Menu

Figure 5 shows the main menu, which is located along the left side of the display screen.

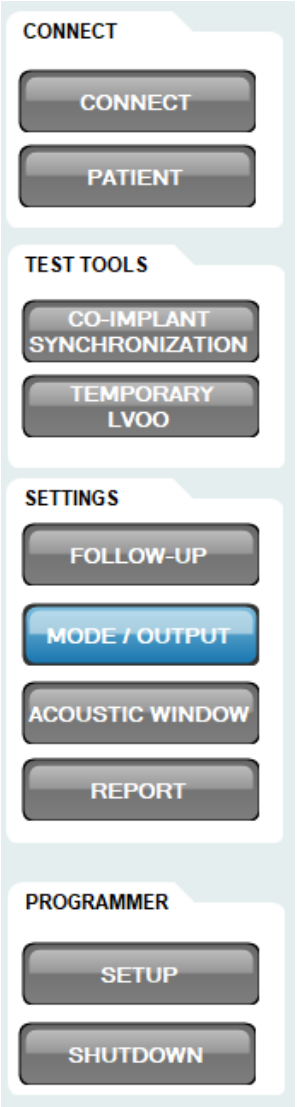


Figure 5. The Main Menu Located along the Left Side of the Display Screen

2.1.5 Programmer Setup

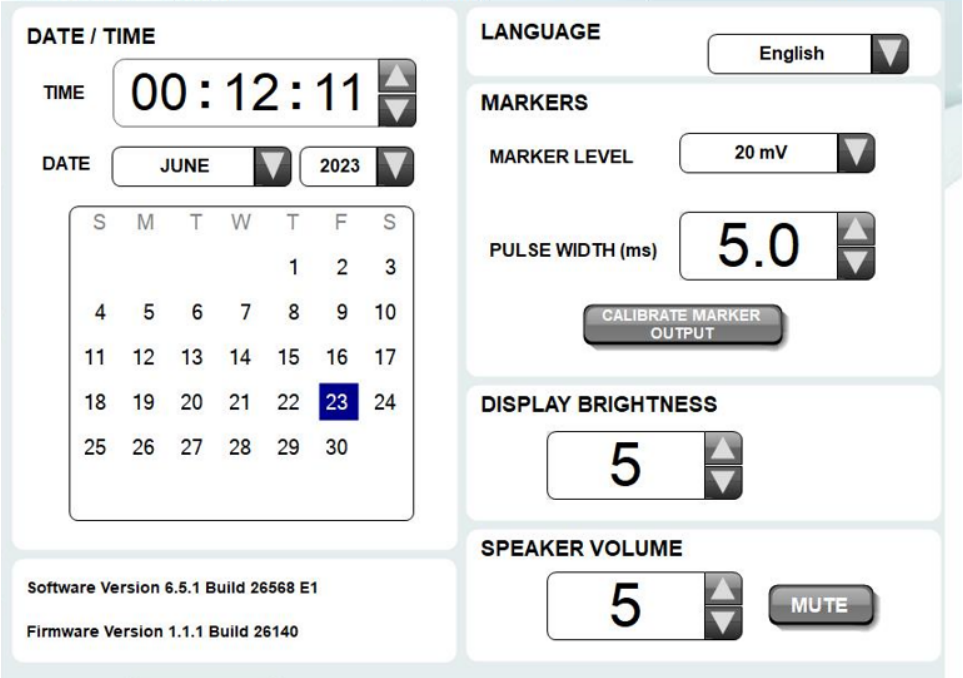


Figure 6. Programmer Setup Screen
Accessible by pressing the [SETUP] button from the main menu (Figure 5)

Programmer setup can be accomplished via the Programmer Setup Screen (**Figure 6**).

The time and date are adjusted by selecting the associated buttons.

By selecting the associated buttons, the local language for the buttons and messages, the brightness of the display, and the volume level of the Programmer's speaker may be adjusted.

The analog outputs for the Marker Events are adjusted by selecting the associated buttons. To test the Marker Events output levels, select the [CALIBRATE MARKER OUTPUT] button. For additional information about using Marker Events and the Programmer output signal when the [CALIBRATE MARKER OUTPUT] button is pressed, refer to **Section 2.2.2**, Using Marker Events **Figure 10**.

2.2 ESTABLISHING A COMMUNICATION SESSION WITH A TRANSMITTER

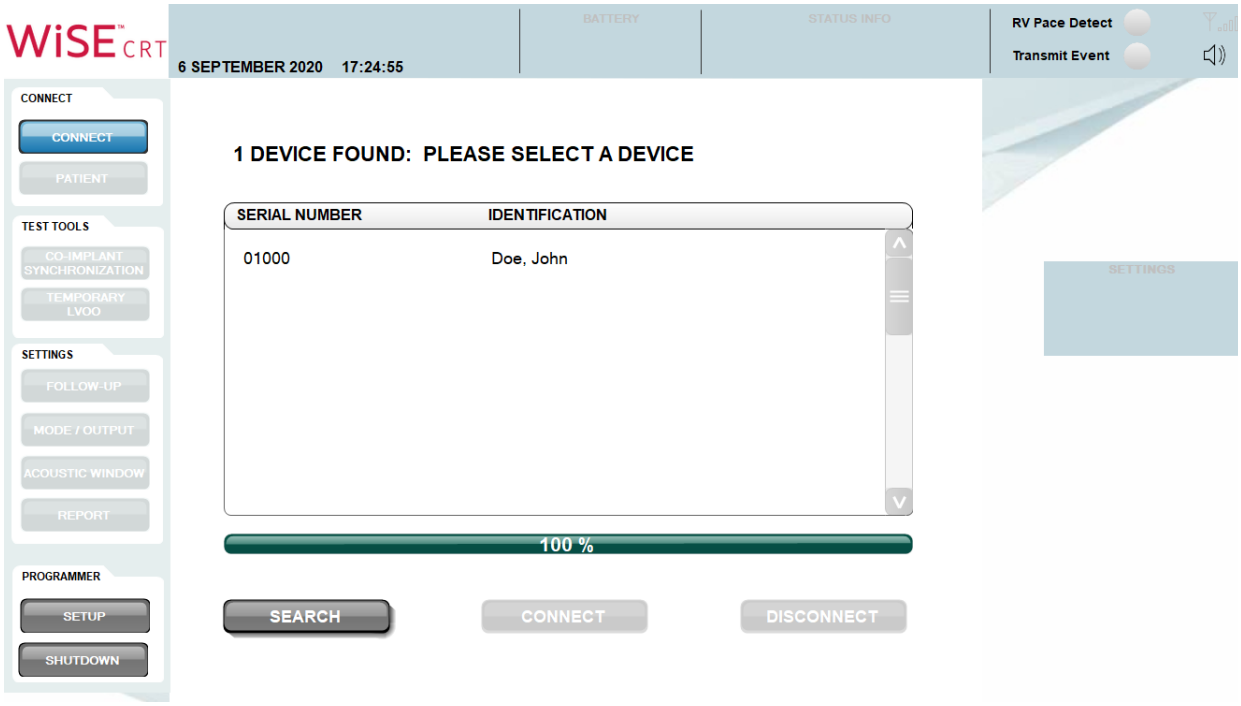


Figure 7. Connect Transmitter Screen
Accessible by pressing the [CONNECT] button from the main menu (Figure 5)

Select the [SEARCH] button to initiate a radio module scan for WiSE CRT Transmitters (**Figure 7**). The scan may take up to 30 seconds and the progress bar will fill as the radio module scans for devices. The radio module's indicator light will blink green while scanning for devices and turn solid green if a device is identified. All devices that are found by the scan are listed by serial number and by patient name, if the patient name has been programmed into the Transmitter.

Select the appropriate device from the list. Select the [CONNECT] button on the bottom of the window to establish a session; select the [DISCONNECT] button to stop a session and select a different Transmitter from the list.

If the radio connection between the Programmer and the Transmitter stops communication, the No Communication with the Pulse Generator Dialog Box will be displayed. To resume a programming session with the same Transmitter, select the [RECONNECT] button in the dialog box.

2.2.1 Programmer Status Bar

The Programmer Status Bar (**Figure 8**) is continuously displayed at the top of the screen and contains a radio signal strength indicator for the link between the radio module and the Transmitter and a section that updates Marker Events in real-time as an indicator of Transmitter operations.

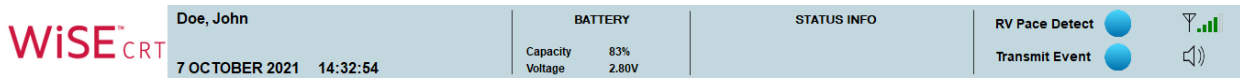


Figure 8. Programmer Status Bar Located at the Top of the Display Screen

2.2.2 Using Marker Events

The WiSE CRT Transmitter communicates the occurrence of real-time operational events to the Programmer using the radiofrequency (RF) communication link. The Programmer provides two types of outputs to signal the occurrence of these events: 1) via flashing indicator icons on the display and 2) via an analog output channel that when connected to typical recording equipment aligns the event signal output with ECG signals.

Two real-time operational events are communicated by the Transmitter with flashing icons and audible tones:

1. The detection of a right ventricular (RV) pacing electrical output spike originating from the co-implanted device, referred to as an *RV Pace Detect Event*.
2. The transmission of an ultrasonic pulse directed at the Electrode intended to pace the left ventricle, referred to as a *Transmit Event*.

During acoustic window testing, counts of events are displayed next to the icons. Audible tones are enabled by selecting or deselecting the speaker icon (**Figure 9**).

Figure 9. Marker Event Audible Tones can be Disabled by Selecting the Speaker Icon

Marker Events are dependent on the programmed settings and the operational mode of the Transmitter. In RV Synchronous mode:

- *RV Pace Detect* and *Transmit Event* occur with a pacing spike detection that triggers ultrasound transmission.
- *RV Pace Detect Events* occur with pacing spike detections that do not trigger an ultrasound transmit, for example if the detection occurs within the high-rate limit interval (430 ms) or the ultrasound transmission does not occur due to an inability to target the Electrode.

Marker Events are discernible on an analog output channel by interpretation of the polarity and the amplitude of square wave signals (**Figure 10**). The signal amplitude and pulse width, as well as a calibration output, for the signals may be established in the Programmer Setup Screen previously described (**Figure 6**). Inputting the analog signal into recording and display instrumentation that is monitoring the ECG will assist with setup of the System, evaluation of operation, and troubleshooting. Marker Events are also discernible when the audio output is enabled (**Table 2**).

Table 2. Marker Event Audio Outputs

Event	Marker Pulse	Tone
RV Pace Detect and Transmit Event	Full amplitude positive	High pitch tone
Asynchronous Transmit Event	½ amplitude positive	High pitch tone
RV Pace Detect without Transmit Event	Full amplitude negative	Low pitch tone

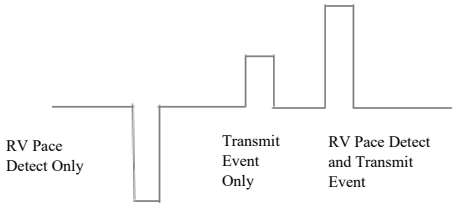


Figure 10. Marker Event Calibration Sequence

2.2.3 Transmitter Status Bar

The Transmitter Status Bar is continuously displayed at the top of the screen and on the right-hand side of the screen (SETTINGS area). Current settings and status of the Transmitter may be viewed at any time (**Figure 11**). The status bar contains a section to report the last measured Battery voltage, estimated remaining Battery life capacity, and a section to report any status conditions such as device resets or end of service flags.

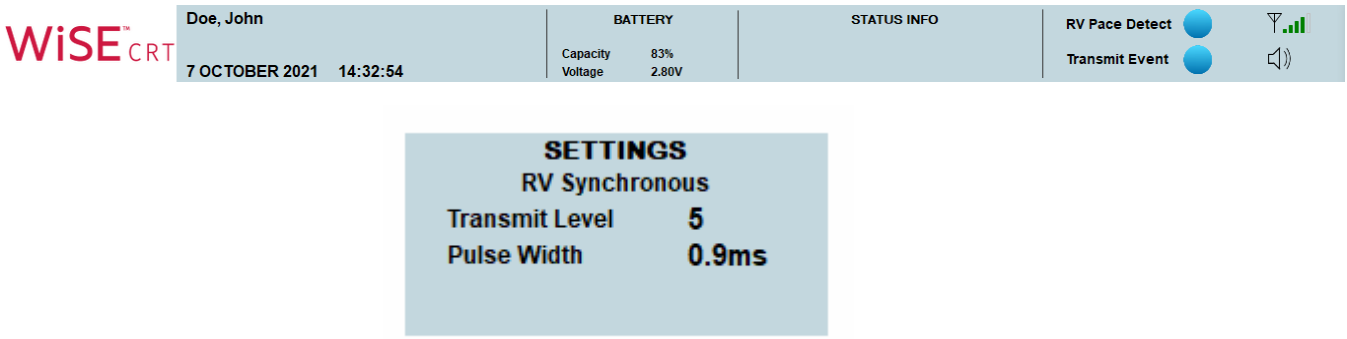


Figure 11. Transmitter Status Bar Located at the Top of the Display Screen with SETTINGS Area Located to the Right of the Display Screen

2.3 REVIEWING DEVICE DATA

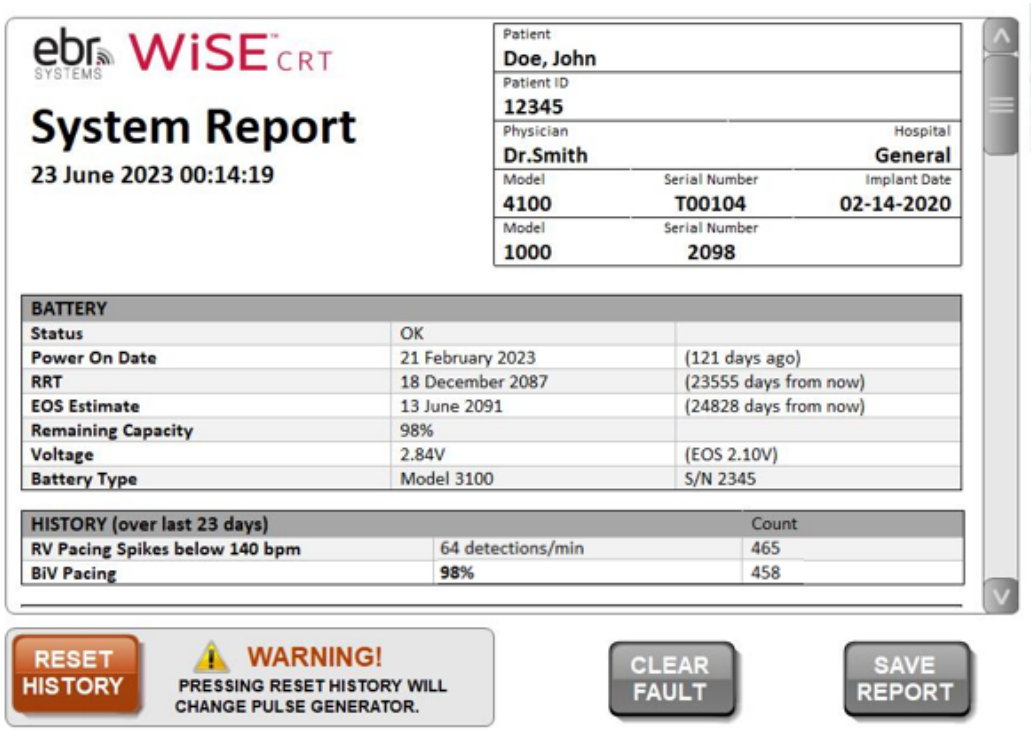


Figure 12. Report Screen
Accessible by pressing the [REPORT] button from the main menu (Figure 5)

After connecting to a Transmitter, the Programmer will interrogate the device for its settings and data and display the Report Screen (**Figure 12**). To review the complete settings and data, use the scroll bar to adjust the window view.

To send the settings and data report directly to the USB memory modules connected to USB port on the radio module select the [SAVE REPORT] button.

Select [CLEAR FAULT] to reset errors that may have been reported.

The collected data in the device may be cleared after selecting the [RESET HISTORY] button to clear/ reset the counter and statistic data. The following data will be cleared:

- Total number of RV pacing spike detections
- Total number of left ventricular (LV) pace attempts
- RV pacing spike detection data
- Electrode location and distance statistics

2.4 Programming Permanent Transmitter Parameters

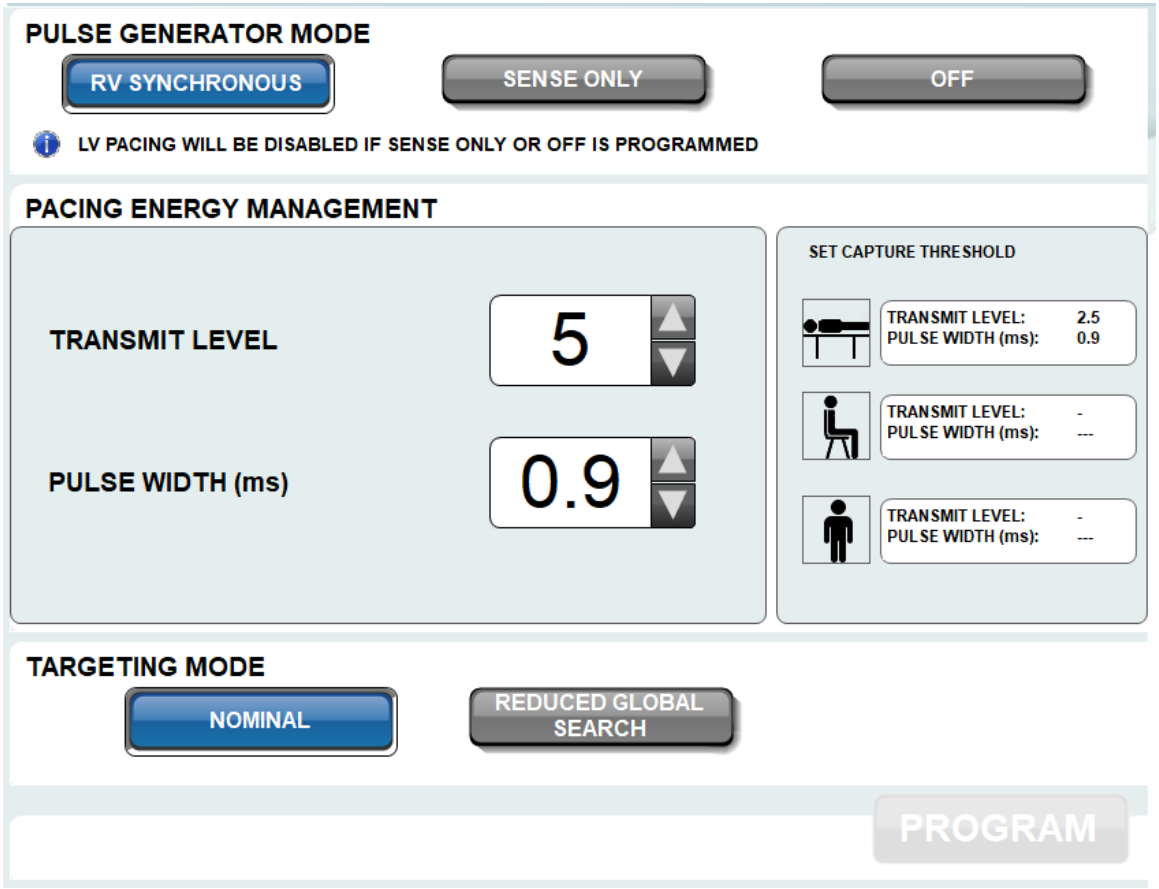


Figure 13. Mode/ Output Screen
Accessible by pressing the [MODE/OUTPUT] button from the main menu (Figure 5)

The Transmitter may be programmed to one of three operational modes (**Figure 13**):

- **RV Synchronous** – This is the pacing mode for the Transmitter. In this mode, the Transmitter senses RV pacing electrical outputs from the co-implanted pacemaker or defibrillator and

immediately triggers an ultrasonic transmission to the Electrode to pace the left ventricle for BiV pacing.

- **Sense Only** – This is a sensing mode that disables LV pacing but allows the device to track, count, and transmit RV Pacing Spike Detection Marker Events.
- **Off** – This mode disables pacing and sensing in the device. This is the factory default setting of the device.

In RV Synchronous mode the Transmitter may be programmed to fixed settings for the transmit level and pulse width. The pulse width is analogous to the pacing pulse width in a conventional pacing pulse. The setting of this pulse width determines the delivered pulse width for the LV pace pulse. The transmit level does not correlate to a specific electrical pacing voltage amplitude. The transmit level is related to the intensity of the ultrasonic output field and is indirectly correlated to the delivered pace pulse amplitude.

The Transmitter may be programmed to one of two targeting modes. Targeting is essential for efficient transfer of energy from the Transmitter to the Electrode. Targeting sends a series of short ultrasonic pulses toward the last known region or location of the Electrode and senses the Electrode's electrical output response. A sufficient electrical response indicates that the Transmitter is focused on the Electrode.

- **Nominal** – This is the default targeting mode in the Transmitter. This mode uses the recent history of electrical responses to the targeting pulses to gauge the system's effectiveness on targeting the Electrode.
- **Reduced Global Search** – This targeting mode is used in circumstances where the system would otherwise use a significant number of targeting pulses to unsuccessfully locate the Electrode. This mode is used to conserve energy usage in the System.

To program the Transmitter parameters:

1. Select the [RV SYNCHRONOUS], [SENSE ONLY], or [OFF] button.
2. If [RV SYNCHRONOUS] is selected, then select the transmit level and the pulse width settings for the device.
3. If [RV SYNCHRONOUS] is selected, then select the [NOMINAL], or [REDUCED GLOBAL SEARCH].
4. Select the [PROGRAM] button.

There are three 'Set Capture Threshold' buttons to the right of the transmit level and pulse width selections. These are used to record the capture threshold values for transmit level and pulse width in various postures (i.e., supine, sitting and standing), which are then displayed on the report for that follow-up session. Select the icon or the value display area to set these values to those that are currently active in the Transmitter. The thresholds are saved in the transmitter for reference in subsequent follow-up.

2.5 PATIENT INFORMATION AND DEVICE TRACKING

Figure 14. Enter Patient Information Screen
Accessible by pressing the [PATIENT] button from the main menu (Figure 5)

The tracking of patients and devices is an important safety requirement. Information must be entered into the Transmitter using the Programmer (**Figure 14**), and an Implanted Device Registration Form must be submitted/ completed and returned to EBR.

To enter a Patient Information data field, select the data field to highlight it and then use the on-screen keyboard to enter alphanumeric information. Obtain the serial number from the packaging, registration cards, or patient records and check for its correct entry. Check other data entry information against patient records. Selecting the Battery Model data field will display the Select Battery Model Dialog Box. The Battery serial number must be entered manually after every new implantation or Battery replacement procedure.

Select [PROGRAM] to communicate and confirm the changes to the Transmitter.

2.6 TEST AND EVALUATION TOOLS

Precaution: Before disconnecting the Programmer from the WiSE CRT device, the user should check that final programming setting are as intended and if appropriate, should verify BiV pacing using ECG.

2.6.1 Initializing Synchronization with the Co-Implant

The WiSE CRT System relies on detecting RV pacing electrical outputs (spikes) from the co-implanted pacemaker or defibrillator. The WiSE CRT Transmitter must be initialized with specific RV pacing pulse width from the co-implanted device to reliably discriminate RV pacing from atrial pacing. This must be done at implant and may be re-initialized during follow-up.

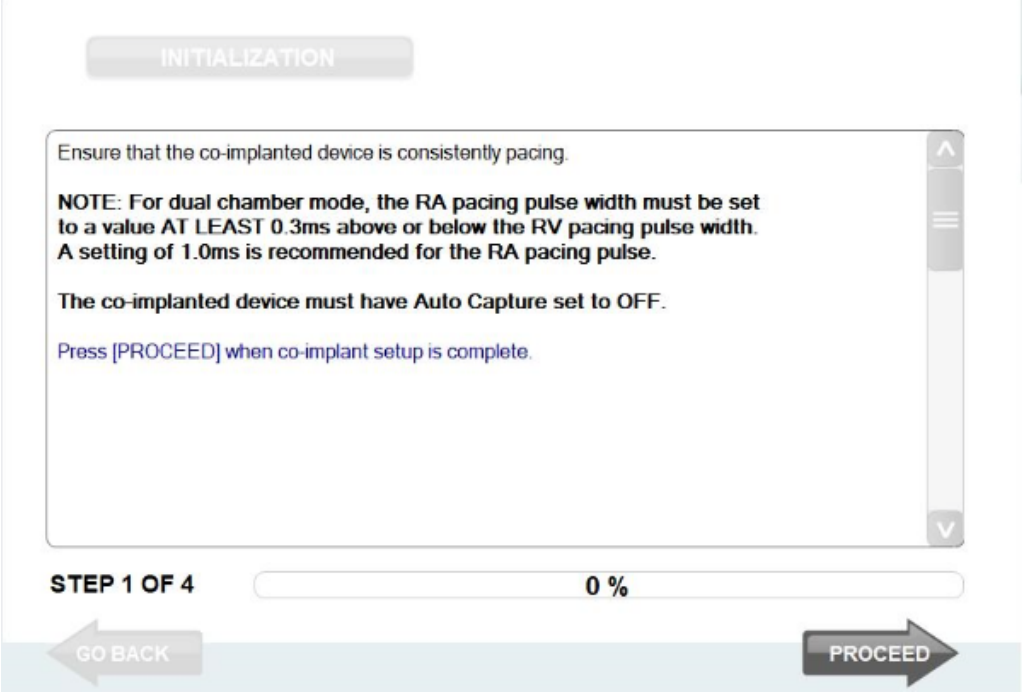


Figure 15. Co-Implant Synchronization Screen

Accessible by pressing the [CO-IMPLANT SYNCHRONIZATION] button from the main menu (Figure 5)

The process requires the operator to interact with both the co-implant device and with the Transmitter. More specifically, the co-implant device must be programmed to specific values for the RV pacing pulse width and the atrial pacing pulse width.

Select the [INITIALIZATION] button after the process has begun to start over.

On-screen directions are provided in the text area to set up the co-implant parameters and verify the initialization (**Figure 15**):

1. Set the co-implant to provide RV pacing.
2. Set the co-implant ventricular and atrial pacing pulse widths within the required bounds. The WiSE CRT Transmitter must be initialized with the pacing pulse widths being used by the co-implanted device. The RV pacing pulse width of the co-implant pacemaker must be programmed at or above 0.35 ms. In dual chamber modes, where atrial pacing may be expected, the right atrial pacing pulse width of the co-implant pacemaker must be programmed at least 0.3 ms above or below the RV pulse width. A setting for right atrial (RA) pulse width above 1.0 ms is most effective for the Transmitter to distinguish atrial pulses from ventricular pulses.
3. Select the [PROCEED] button to confirm that the co-implant is providing RV pacing. The Enter Co-Implant Pacing Pulse Widths Dialog Box (**Figure 16**) will appear for the operator to specify the RV pacing pulse widths being used. Select the scroll-up and scroll-down buttons to enter the RV pacing pulse width. Right ventricular pulse width value selections may not exactly match the resolution value of the co-implant. In this case, select the value that is the closest to the actual programmed value in the co-implant. Select [ACCEPT] to use the pulse

width value and begin the initialization. Select [CANCEL] to start the process from the beginning.

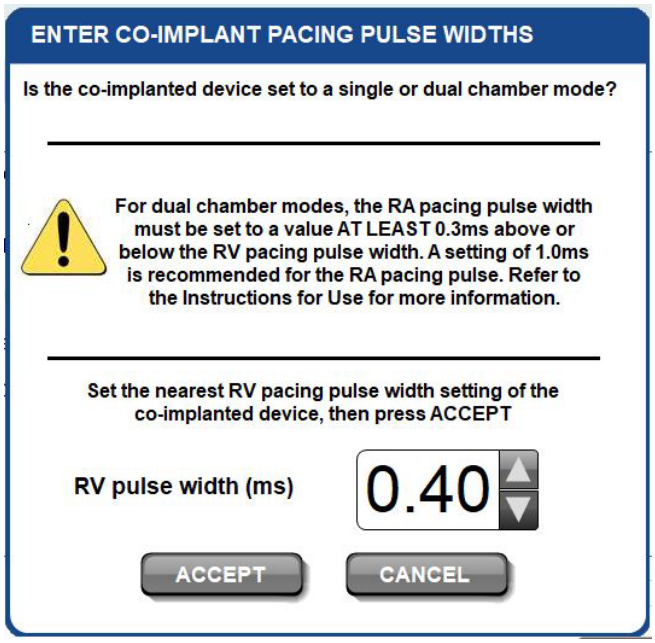


Figure 16. Enter Co-Implant Pacing Pulse Widths Dialog Box

4. Use the Marker Events to confirm that the Transmitter is sensing RV pacing electrical outputs. The RV Pace Detect icon should be flashing in the Marker Event section of the Transmitter Status Bar. Confirm that the Marker Events are synchronized to RV pacing with the ECG on the recording system. Optionally, analog output Marker Events can be displayed on an electrophysiology (EP) recording system.
5. The progress bar will reach 100% when synchronization with the co-implanted device completes. If the Transmitter is unable to synchronize with the co-implant, the user will be shown a message “RV Pacing Spike Initialization unsuccessful” and can press the [PROCEED] button to start over. Once co-implant synchronization has succeeded the user can select the [PROCEED] button to confirm to the Transmitter that it is sensing RV pacing electrical outputs. Select the [GO BACK] button to start the process over.

Note: 1) The user should not leave the co-implant SYNCHRONIZATION screen until either: 1) Synchronization has been completed or 2) Synchronization has timed-out. If the user completes Synchronization and wishes not to PROCEED to lock in the Synchronization, then exit the screen by pressing the [REPORT] button.

2.6.2 Follow-Up Screen

The Follow-Up Screen (**Figure 17**) is used for the Simplified Follow-Up:

Precaution: The Simplified Follow-Up process should be performed **ONLY WHEN**:

1. Initial Device Optimization was performed, e.g., Pre-Discharge Follow-Up, resulting in:
    - Consistent RV Pace Detect
    - Consistent Electrode Tracking
    - Consistent BiV Pacing
2. The required minimum of 12-hour data is available

Targeting Optimization parameters and controls:

- Determining pacing capture thresholds in three postures
- Setting pacing energy and reviewing an adjusted estimated end of service (EOS) date
- Reviewing a summary of parameters that have changed
- Testing the M4100 Transmitter low battery speaker

Help icons are included on the Follow-Up Screen to assist with the process. The trash bin appears when transmit level and pulse width values are present in the threshold area. To remove a threshold for a posture, select the trash bin icon. The revert icon is shown when a threshold for a posture has been removed. To restore a priorly removed threshold, select the revert icon.

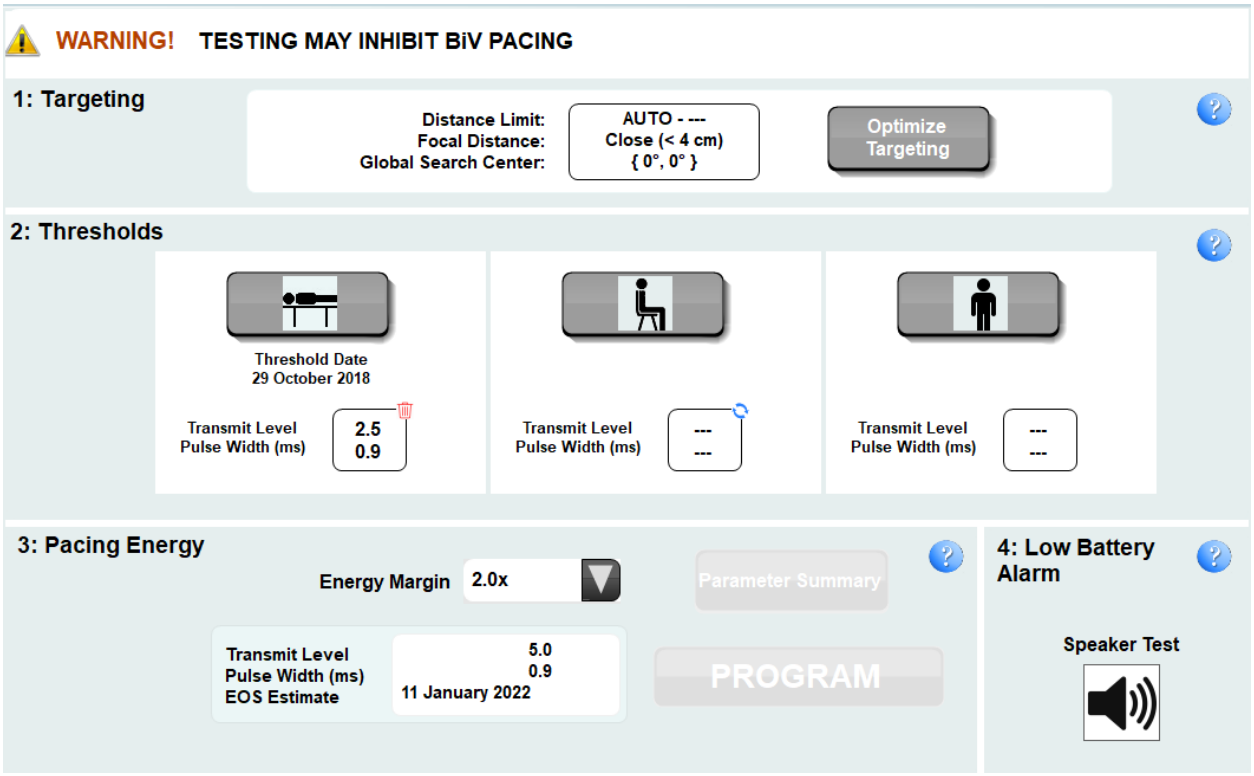


Figure 17. Follow-Up Screen

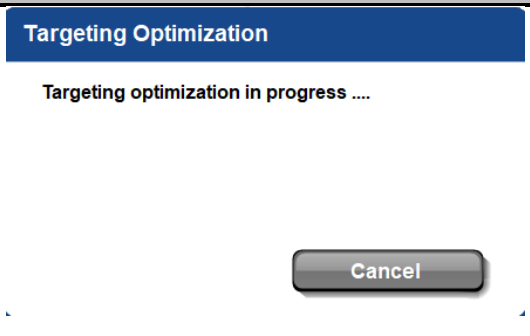
Accessible by pressing the [FOLLOW-UP] button from the main menu (Figure 5)

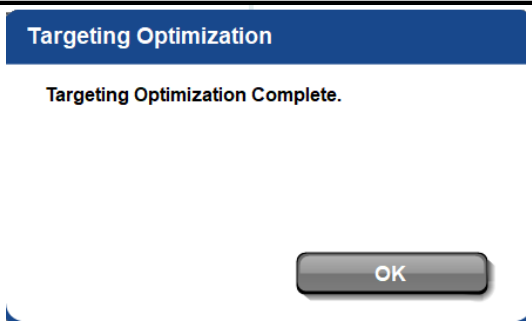
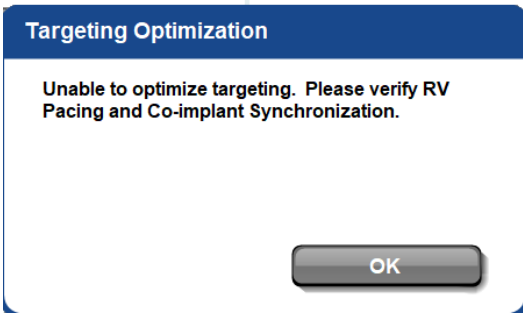
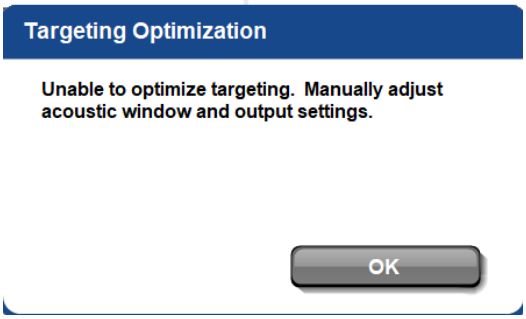
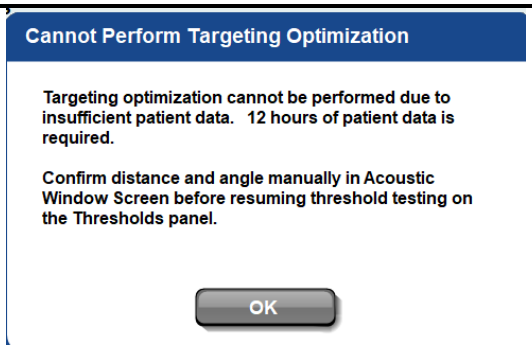
2.6.3 Targeting Optimization

The [Optimize Targeting] button initiates an automated targeting evaluation that will set the distance and global search center parameters to optimize locating the Electrode. The optimization is based on the device's historical distance and angle data collected from the Transmitter. **Table 3** shows targeting optimization states and associated dialogs.

Precaution: Pacing capture in the left ventricle may be intermittent while targeting optimization is operating.

Table 3. Targeting Optimization State and Dialogs Shown

Targeting Optimization State	Dialog shown
In-process	

Targeting Optimization State	Dialog shown
Successful completion	
Fails to complete: No detection of co-implant pacing	
Fails to complete: Unable to detect the position of the Electrode	
Fails to complete: Less than 12 hours of data was received from the Transmitter in RV Sync mode	

Note: If mean electrode distance <= 3.4cm, the distance limit will remain at presenting value.
If mean electrode distance >3.4cm and <= 5.4cm, then the minimum distance for the CLOSE field is set to 3.4cm.

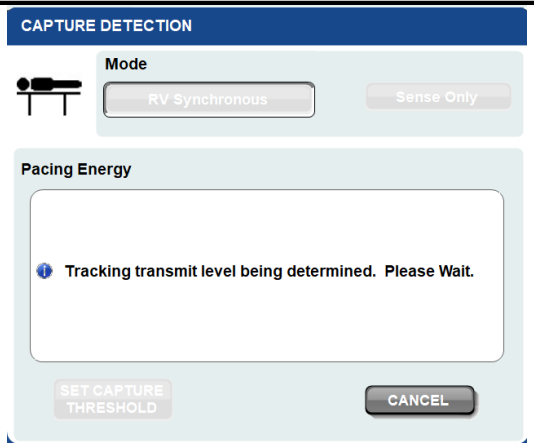
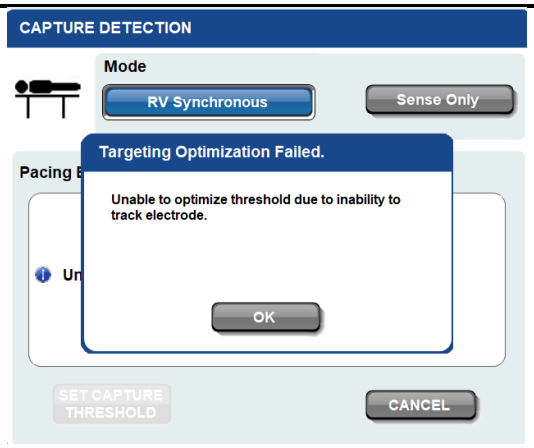
2.6.4 Threshold Testing

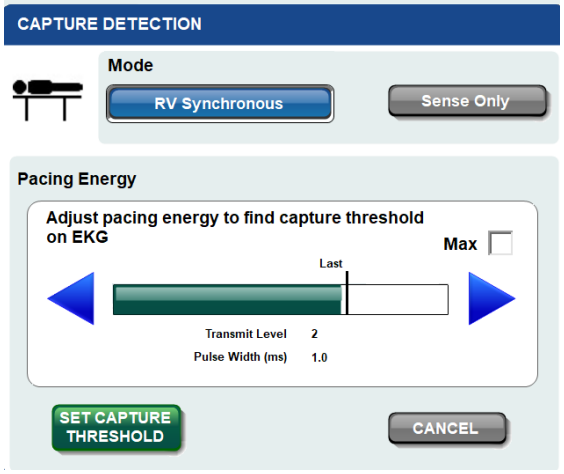
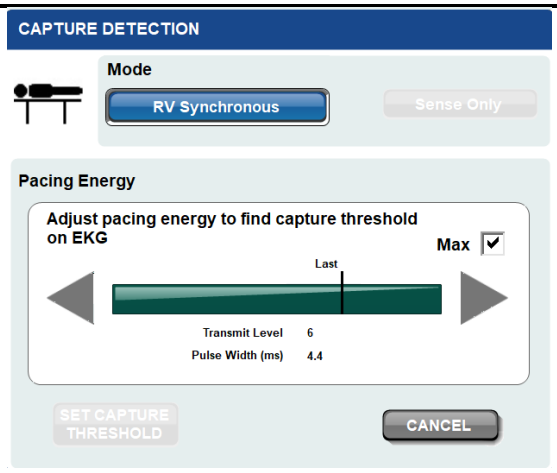
Threshold testing should be performed in supine, sitting and standing postures, if the patient is able. This is required to optimize the overall output by taking into account the minimum required pacing energy in those three positions.

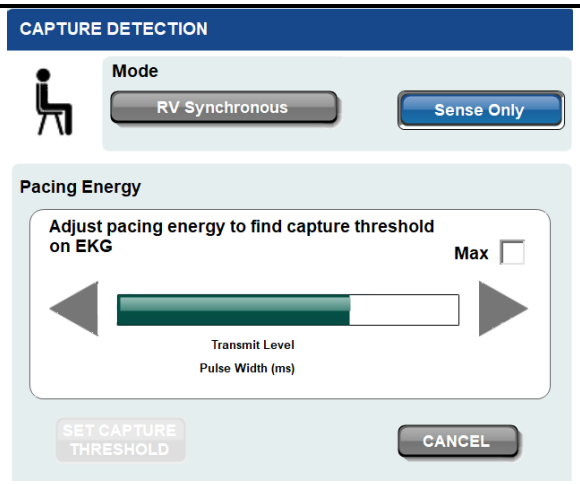
Select one of the posture buttons on the screen to initiate the test. Error! Reference source not found. walks through setting a threshold in the supine posture.

Precaution: Pacing capture in the left ventricle may be intermittent while threshold testing is performed.

Table 4. Walkthrough Setting a Threshold in the Supine Posture

Capture Detection Dialog State	Dialog Shown
In-Process	 Upon entry, the Programmer attempts to determine the minimum Transmit Level that is required to consistently track the Electrode.
Fails to complete: Unable to track Electrode	

Capture threshold determined	 Upon determining tracking Transmit Level, the programmer sets the PW to 1.0 ms. Then, with use of an EKG to assess the pacing capture threshold, the user adjusts the Pacing Energy with the increase/ decrease buttons in the Capture Detection dialog. As a reference, the ***Last*** recorded pacing capture threshold is shown as a vertical bar on the energy scale.
Selecting Maximum pacing energy	 The maximum energy output from the Transmitter may be selected by checking the Max box in the dialog. With Max selected, the Transmit Level is set to 6 and Pulse Width is set to 4.4 ms. Upon de-selecting the Max box, the Transmitter is reprogrammed to the Transmit Level/ Pulse Width settings that were in use just prior to selecting the Max box.

Selecting Sense Only	 With Sense Only selected, the device is programmed to Sense Only mode, and the Set Capture Threshold button is not selectable. This setting allows the user to evaluate the QRS morphology on EKG when the Transmitter inhibits BiV pacing.

2.6.5 Pacing Energy

User can set an energy margin and review the effect on the EOS date under Step 3 - Pacing Energy (**Figure 18, Figure 19**).

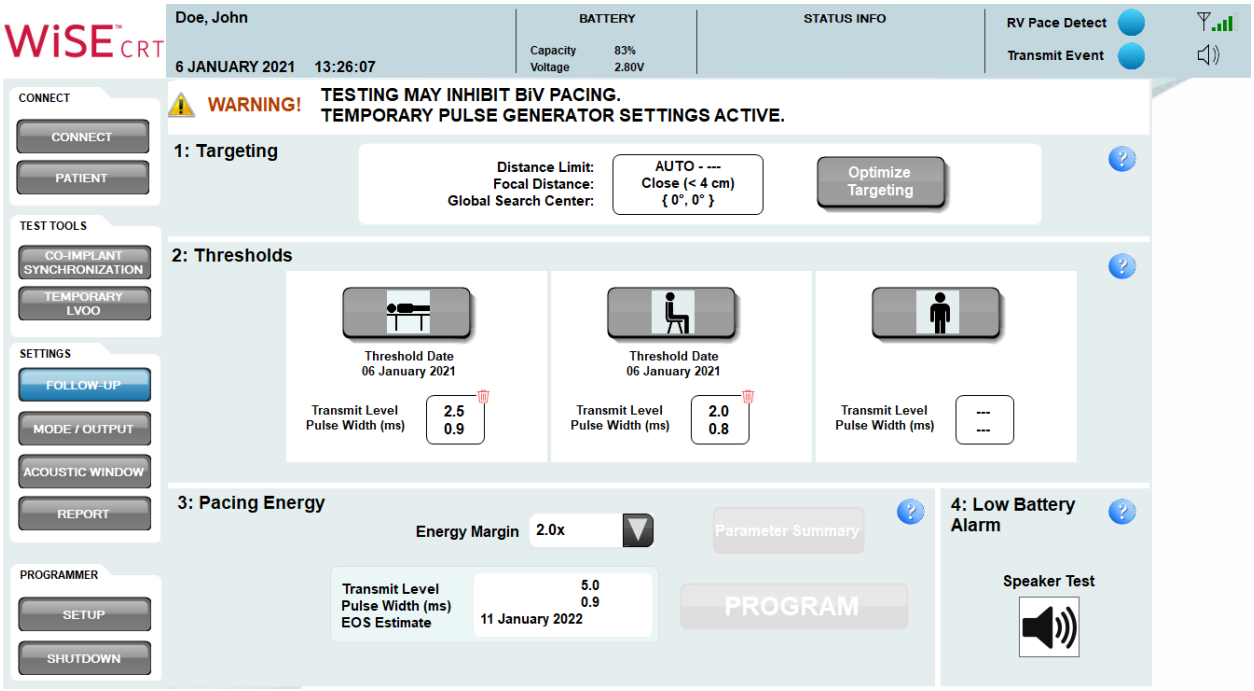
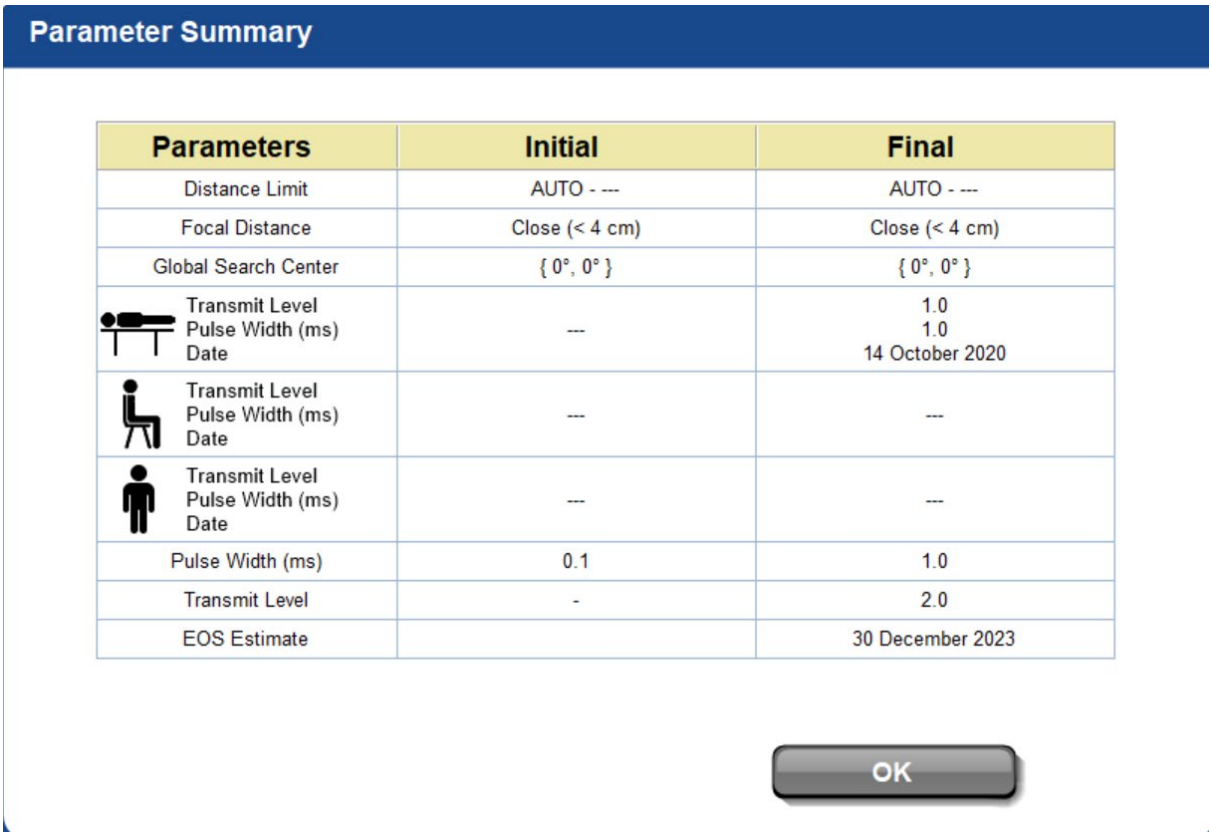


Figure 18. Follow-Up Screen
Follow-Up Screen with temporary pulse generator settings active

Figure 19. Pacing Energy
The energy margin can be selected from a drop-down menu in the pacing energy section

2.6.6 Parameter Summary

The [Parameter Summary] button is used to review the initial parameters, thresholds and the final parameters to be programmed when the [PROGRAM] button is pressed.



Parameters	Initial	Final
Distance Limit	AUTO - ---	AUTO - ---
Focal Distance	Close (< 4 cm)	Close (< 4 cm)
Global Search Center	{ 0°, 0° }	{ 0°, 0° }
Transmit Level Pulse Width (ms) Date	---	1.0 1.0 14 October 2020
Transmit Level Pulse Width (ms) Date	---	---
Transmit Level Pulse Width (ms) Date	---	---
Pulse Width (ms)	0.1	1.0
Transmit Level	-	2.0
EOS Estimate		30 December 2023

Figure 20. Parameter Summary
Accessible by pressing the [Parameter Summary] button on the Follow-Up Screen

2.6.7 Low Battery Alarm

The Low Battery Alarm panel provides the user with a mechanism to test the M4100 Transmitter speaker (See the Transmitter M4100 Speaker Test for Battery section of the IFU for more information). When the [PROGRAM] button is enabled (orange), the Speaker Test button is not accessible (light grey).

2.6.8 Acoustic Window Screen

Precaution: Pacing in the left ventricle may be inhibited while set up of the acoustic window is operating.

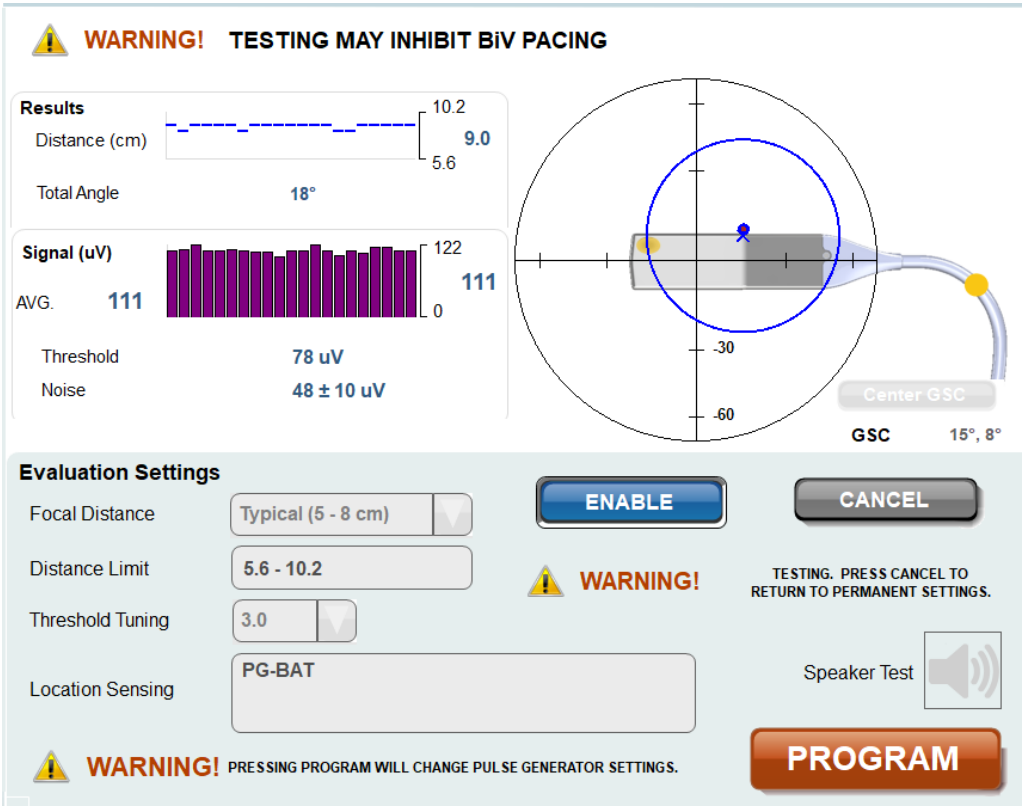


Figure 21. Transmitter M4100 Setup Acoustic Window Screen

Accessible by pressing the [ACOUSTIC WINDOW] button from the main menu (Figure 5)

The set-up of the acoustic window evaluates the position of the Transmitter array relative to the Electrode position. All array elements are active during testing and are not adjustable. The screen shows the location and sensing signal values as measured in real time. The Transmitter locates the Electrode (**Figure 21**) and shows the acute effect of the current parameters being tested. The following characteristics are visible in the graphic display:

- Information related to the acute location and distance to the Electrode, relative to the face of the Transmitter, is continuously displayed as a blue dot on the graphic and as an actual distance and angle value in the Results next to the graphic.
- The graphic depicts a circular representation of the full 180-degree hemisphere beneath the Transmitter, with tick marks along the x- and y-axes indicating ± 30° and 60°. The targeting zone for locating the Electrode is shown by a blue circle. The center of the circle is marked as a blue “x”. This “x” and the corresponding target zone may be positioned anywhere within the

180-degree hemisphere. The blue dot is expected to be within the target zone and generally near its center.

- One or more location Sensors being used by the System to locate the Electrode are highlighted by yellow dots in the graphic display. These are in the general location for the sense electrodes arranged on the image of the Transmitter. The location Sensor configuration being used is also displayed below the graphic and programmed as described below.
- Data areas to the left of the graphic display provide information on:
    - The Signal (μV) - Electrical amplitude outputs by the Electrode as sensed by the Transmitter in response to a targeting pulse. It is used to indicate the relative strength of the sensing signal used to locate the Electrode. The signal data itself is displayed as an absolute value and as a moving average (AVG).
    - Noise – Electrical background signal noise present in the sensing signal.
    - Threshold – A function of the noise and a statistical history of the noise.
- Signal, Noise, and Threshold are used to determine whether the Transmitter is sufficiently focused on the Electrode. The System uses the sensed signals above the threshold to determine whether the ultrasound pulse is targeted on the Electrode. The higher the signal is above the noise, the more statistically likely it is that the targeting is accurate. The function can be modified by selecting a Threshold setting in the pull-down menu.

At implant or at discharge, set up of acoustic window alignment with the Transmitter's transducer array should always be completed.

To use the Programmer for this assessment:

1. Position the "x" representing the center of the target zone at the expected Electrode location, by touching the desired center of the target zone using the touchscreen. If the Electrode has been previously found and tracked, a red ellipse will be displayed indicating the average location of the electrode. The "x" may be placed within that ellipse manually by tapping at the new location, or by pressing [CENTER GSC] which will automatically adjust it to the center of the ellipse.
2. Select a targeting range from the Transmitter to the Electrode's location by selecting a Focal Distance using the pull-down menu. The Distance is used by the system to focus the Transmitter's ultrasound output. The measured range is displayed as an actual value in the Results screen area. The selections for the Distance are in centimeters of separation between the Electrode and the Transmitter face and include [Close (< 4)], [Near (4 – 5)], [Typical (5 – 8)], and [Far (> 8)]. The Distance is normally selected based on the measured value reported. If the Electrode is at a large angle, performance may be improved by selecting a Focal Distance that is greater than the measured distance displayed. The Distance pull-down menu also contains a setting labeled "Off". Selecting "Off" may be preferable for especially large Transmitter-to-Electrode angles (total angle > 45˚). The Total Angle is displayed to the Distance measured value.
3. Select the Distance Limit display area to open the Select Distance Limit Dialog Box (**Figure 22**) to select the sensing range. When the CLOSE distance is set to AUTO, the system automatically calculates the minimum sense blanking distance. In many cases, targeting can be improved by manually selecting a CLOSE sensing distance. Typically choose a CLOSE

distance that is at least 2 cm less than the expected minimum Electrode distance. The FAR distance is typically set to at least 2 cm farther than the expected maximum Electrode distance, up to a maximum of 16.9 cm. Select [ACCEPT] or [CANCEL] to close the dialog box.

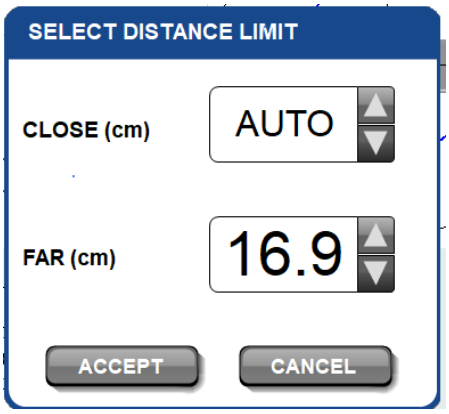


Figure 22. Select Distance Limit Dialog Box

4. Select the Location Sensing configuration to display the Select Location Sensing Dialog Box (**Figure 23**). The configuration may be selected from a single sensor and/or from dual sensor pairs. These pairs represent combinations of sensing electrodes on the exterior of the Transmitter and Battery. Up to four selections can be made and can be mixed between single and dual sensors. The System will dynamically rotate the use of these sensors. The rotation occurs during operation at times when the System determines that sensing is inconsistently targeting the Electrode. Select one to four buttons between the Single and Dual columns. Alternatively, the [OPTIMAL SINGLE] selection is an automated feature which the System uses to self-select a sensing configuration. Select [ACCEPT] or [CANCEL] to close the dialog box.

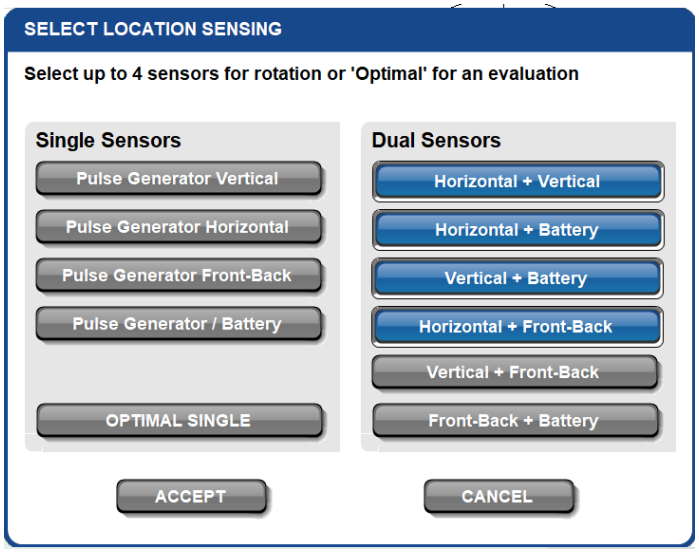


Figure 23. Select Location Sensing Dialog Box

5. To test the modified parameters, select the [ENABLE] button to initiate the test process.

6. Monitor the data display areas to assess the test performance. A beat-by-beat update of the signal level value will be displayed. The average of all values will be displayed as a number. Monitor the Marker Events during the testing. The display will show the counts of RV Pace Detect Events and Transmit Events next to the flashing icons.
7. During the test, the [PROGRAM] button will be enabled. Select [PROGRAM] to permanently set the Transmitter to the configuration being tested.
8. You can only program the settings while the test is in operation.
9. The test process will continue until the [CANCEL] button is selected, until the communication with the Transmitter is interrupted, or until a main menu button is selected to change to another screen. The Transmitter will return to its previously programmed settings of operation.

2.6.9 Transmitter M4100 Speaker Test for Battery

An audible tone exists in the Transmitter M4100 to indicate the progression of the depletion of the implanted Battery. The audible notification is tested from the Setup Acoustic Window Screen (**Figure 21**) or the Follow-Up Screen (**Figure 17**) to determine whether the notification can be perceived by the patient.

Note: At every follow-up, the speaker test for the Battery must be performed. The patient should be educated or re-educated as to the importance of the audible tone and its purpose.

Select the Speaker Test button. The Speaker Test Dialog Box (**Figure 24**) will be displayed for 8 seconds while the speaker in the Transmitter emits the audible notification sequence (five half-second audible tones, separated by one second silence between tones).

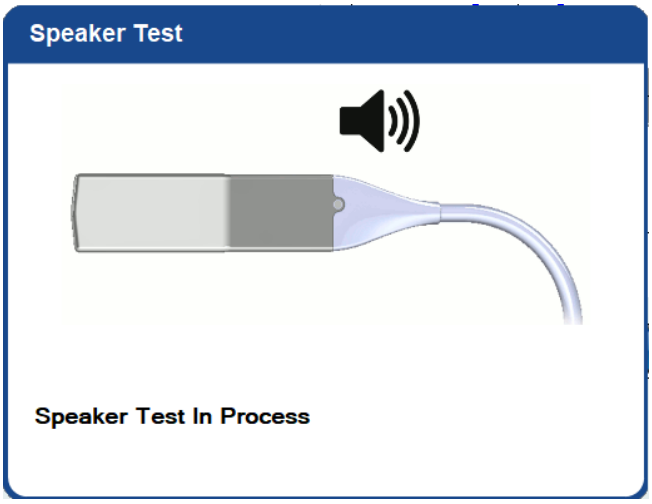


Figure 24. Transmitter M4100 Speaker Test Dialog Box

2.6.10 Initiating Temporary LVOO Mode

The Transmitter may be programmed to temporarily deliver asynchronous pacing to the left ventricle (**Figure 25**).

Note: If Reduced Global Search is programmed, then prior to initiating Temporary LVOO Mode, program NOMINAL Targeting Mode within the Mode/ Output Screen.

Precaution: Temporary LVOO mode delivers pacing without synchronizing to the co-implant. Ensure co-implant rate is lower than the LV rate to avoid competitive pacing.

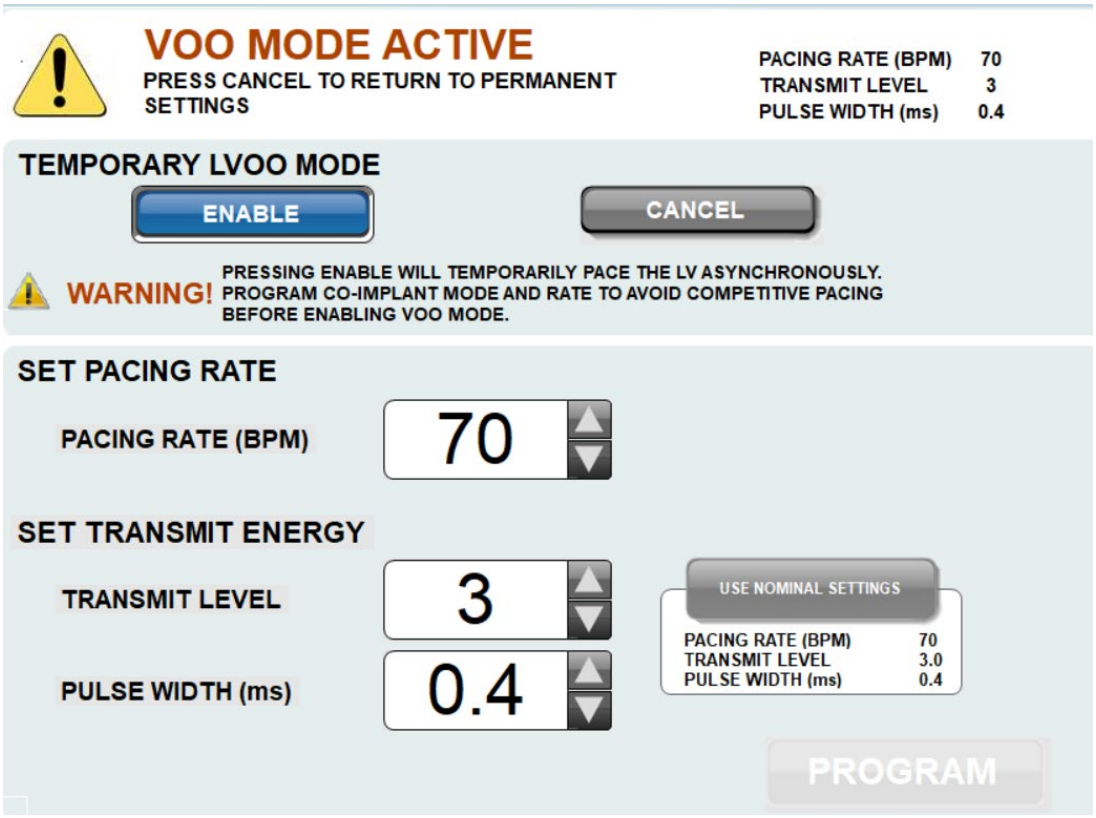


Figure 25. Temporary LVOO Mode Screen
Accessible by pressing the [TEMPORARY LVOO MODE] button from the main menu (Figure 5)

To program the Transmitter to temporary LVOO mode:

1. Select the pacing rate, transmit level and pulse width.
2. Select the [ENABLE] button.

Select [CANCEL] button to terminate the temporary pacing and return to the programmed mode. If at any time the communication link between the Programmer and Transmitter is lost, the temporary LVOO mode will automatically be cancelled by the Transmitter. If Targeting mode was programmed to Nominal to conduct testing in LVOO mode, program Targeting mode back to Reduced Global Search mode within the Mode/ Output Screen.

3 BATTERY INFORMATION

3.1 BATTERY MODEL SELECTION

The Battery Model can be selected or changed in the Patient Information Screen (**Figure 14**). Selecting the Battery Model field will bring up the dialog pictured in **Figure 26**. After selecting the Battery Model that is connected to the Transmitter, select the [PROGRAM] button (**Figure 26**) to save the changes.

Note: For the Transmitter to estimate the service life of the Battery module it must know which Battery Model has been connected. Take care to ensure that the proper Battery Model is recorded by the Programmer. Incorrect programming can lead to misleading end of Battery life estimations.

Note: Select M3100 (Model 3100) (since other Model of the Battery is not available), then press the [PROGRAM] button on your Programmer screen.

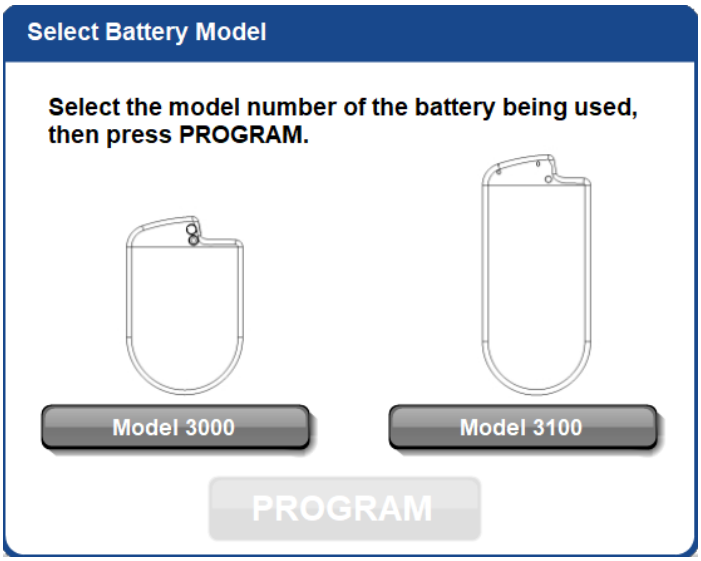


Figure 26. Battery Selection Screen

New Battery Dialog

The Programmer will display a New Battery Dialog (**Figure 27**) after connecting to a device where a reset has been detected. The dialog displays the date the reset occurred.

If a new Battery was installed on the same date of the reset, select [YES]. Otherwise, select [NO].

The user must confirm their selection on the following New Battery Dialog. Selecting [YES] will clear the energy consumption estimate for the Transmitter.

Note: For the Transmitter to provide an accurate estimate of the service life of the Battery module it must reset the energy consumption estimates when a new Battery is installed and NOT reset the energy consumption estimates if no new Battery was installed. Ensure that the New Battery Dialog is answered appropriately. Incorrect programming can lead to misleading end of Battery life estimations.

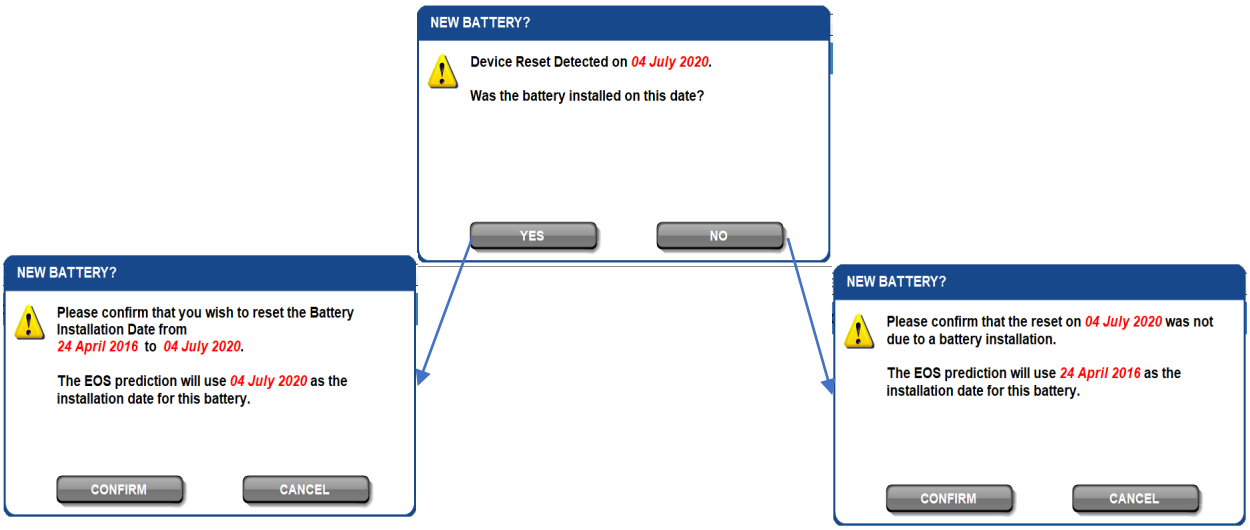


Figure 27. New Battery Dialog

3.2 BATTERY STATUS - EOS, RRT, ERI

The energy usage is monitored by the Transmitter to estimate and report on the service life of the Battery module. Energy usage is based on the individual settings and specific power usage of the device.

The Transmitter Status Bar and the Report Screen contain indications of the Battery status. The Battery status is assessed by the measured Battery voltage, an estimate of the remaining Battery capacity, and estimated dates for end of service (EOS) and recommended replacement time (RRT). In addition to the RRT and EOS dates, the Battery voltage and the estimated remaining Battery capacity are reported on the Report Screen (**Figure 28**) and in the saved report. In the event there is a discrepancy between the RRT and elective replacement indicator (ERI), the user should defer to the ERI as it is triggered by the actual Battery voltage whereas the RRT is based on an estimate of the remaining Battery capacity.

The Programmer provides an estimated EOS date on the Report Screen shown in **Figure 28**. Regular device checks are a critical component of care and the EOS date must be reviewed at each device check. Upon entering EOS, the Transmitter will no longer provide ultrasound transmissions.

If the Battery has reached EOS, the date will be in the past and the Transmitter will be OFF.
The RRT is the estimated date when the device Battery will reach the RRT condition which is defined as 5% remaining battery capacity. If the date has been reached, it is recommended to schedule an appointment with the patient to replace the Battery. In addition to the RRT and EOS, the Battery voltage is measured by the Transmitter and the remaining Battery capacity is estimated. These are also reported in **Figure 28**.

The ERI is when the Battery voltage is measured below 2.36 V. At this voltage, the implanted Transmitter will generate a patient notification consisting of twenty (20) half-second audible tones separated by one second of silence between tones. This patient alert notification repeats every eight (8) hours, until either the Battery is replaced, or the System is programed with settings that extend Battery longevity (e.g., lower transmit levels and wider pulse widths could be used to increase Battery life). The audible notification is tested from the Setup Acoustic Window or the Follow-Up Screen (**Figure 21** and **Figure 17**) to determine whether the audible notification can be perceived by the patient (**Section 2.6.9**).

Note: The Transmitter Status Bar and the Report Data area will contain indications of the Battery status. The measured Battery voltage is reported, an estimate of the remaining Battery capacity is provided, and an estimated date of end of service is reported (ERI = 2.36 V, EOS = 2.1 V).

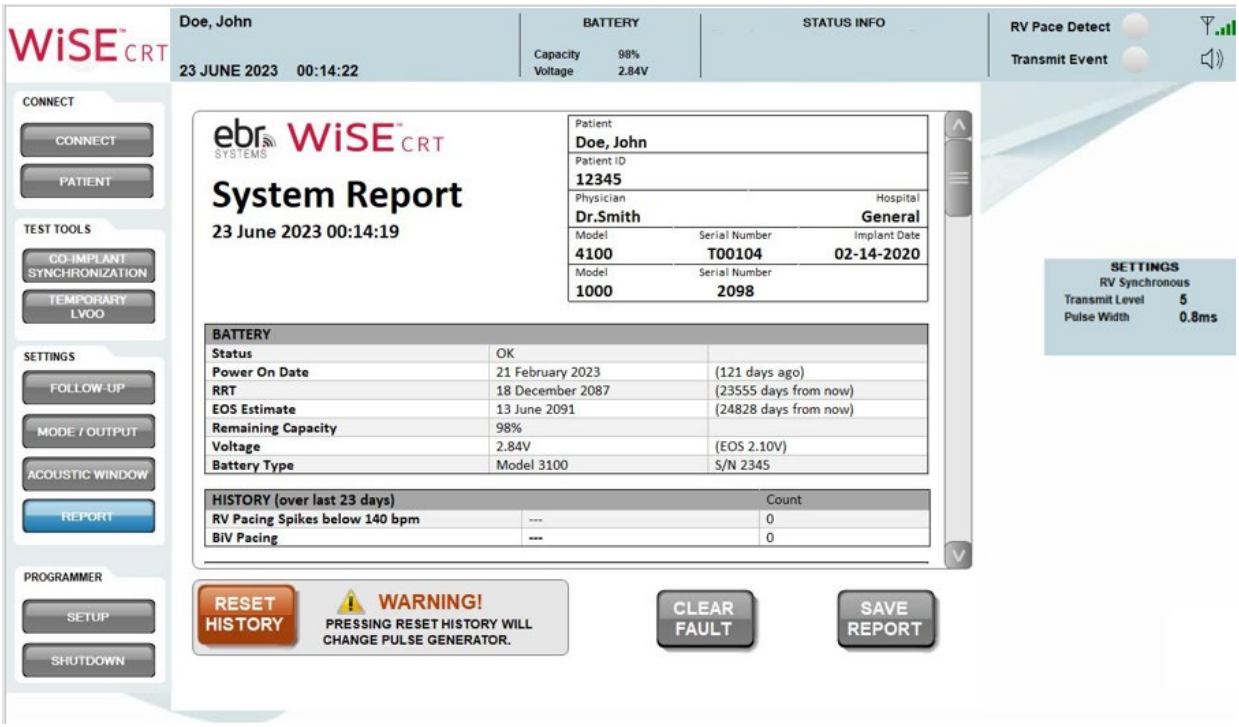


Figure 28. Report Screen Showing Battery Status
Screen is accessible by pressing the [REPORT] button from the main menu (Error! Reference source not found.)

3.3 BATTERY LONGEVITY

Warning – **Reduced Battery Life:** High transmit level and pulse width settings will reduce the service life of the Battery. Periodic patient follow-up is required to assess Battery capacity and projected longevity (i.e., service life) in combination with capture threshold assessments. Discuss with each patient the importance of their regular device check as a critical component of their care. Advise the patients that if they become symptomatic again, similar to their condition before the WiSE CRT System was implanted, they should contact their physician at the implanting center. Advise the patient that their WiSE CRT System can only be assessed at their implanting center.

The longevity of the Battery is affected by several important operating conditions that vary for each implanted system.

Table 5 provides recommendations that should be considered to improve the efficiency of the system:

Table 5. Recommendations to Improve Battery Longevity

Time Point	Recommendations
During implant procedures	• The distance between the Electrode and the face of Transmitter array is 10 cm or less. • Total angle (angle of direction required to transmit ultrasound energy to the Electrode) ≤ 30° • Implant the Transmitter securely to the intercostal muscle over an acoustic window (lung-free and rib-free transmission path to potential LV implant sites) that is at least 1 cm x 2.5 cm. • Implant the Electrode in excitable tissue with an acute electrical capture threshold ≤ 2 V at 0.5 ms pulse width.
During patient follow-up visits	• Optimize programmed transmit level and pulse width setting to achieve consistent LV pacing while maximizing Battery longevity. • Refer to the WiSE CRT report for Battery EOS estimate that is generated by the Programmer and based on the System's current settings. For more information on the WiSE CRT report, see **Section 3.2**.

In the Solve-CRT trial, the average battery service life was 2.31 years (range 0.67–5.00 years). This was based on the analysis of n=70 batteries that utilized at least 90% of usable energy capacity.

As shown in **Table 6**, Battery longevity is affected by RV pacing rate and the programmed transmit level and pulse width.
Note: Projected longevity estimates are based on nominal Battery capacity and device power consumption. Do not interpret these values as precise numbers.

Note: Projected longevity estimates below assume 100% BiV pacing, lower BiV pacing rates due to inability to locate and target the implanted electrode will reduce Battery longevity.

Table 6. Battery Longevity Assuming 100% BiV Pacing

RV Pacing Rate	Transmit Level	Pulse Width	Projected Service Life (years)	Prolonged Service Period (years)
60 ppm	2	0.3 ms	6.72	0.35
60 ppm	3	0.4 ms	4.96	0.26
60 ppm	6	0.4 ms	3.28	0.17
70 ppm	4	0.3 ms	4.25	0.22
90 ppm	6	1.5 ms	0.95	0.05

Note: Under extreme usage scenarios (i.e., pacing rate: 90 bpm, transmit level: 6, pulse width: 1.5 ms), projected service life of the Battery is 0.95 year.

4 TROUBLESHOOTING

Issue Description	Possible Cause	Troubleshooting And Corrections
No LV Pacing	RV Synchronous mode not programmed	• Reprogram Transmitter for synchronous pacing.
	Co-implant is not pacing	• Check and reprogram co-implant device mode and rates.
	No RV pacing spike is being detected	• Check that the co-implant is properly programmed for WiSE CRT RV spike detection. Reinitialize Pacing Spike Detection. • Reinitialize Pacing Spike Detection to shorter RV pulse widths. • Increase RV pace amplitude to test for improved detection.
	Battery depleted, cable fractured, not connected, or connector failed	• Check system status with the Programmer. Replace Battery when depleted.
	Failure of the Electrode **OR** Failure to target the Electrode	• Use Temporary LVOO pacing operation to check for Electrode output (pacing spike) at any energy setting. • Evaluate locations of Electrode and Transmitter on previous and new chest X-rays to check for movement causing no targeting (no pacing spike). • Use acoustic window set up to check for possible movement of the Electrode or the Transmitter causing poor targeting. • Use acoustic window set up to improve targeting by choosing/ optimizing [LOCATION SENSING] electrodes. • Use acoustic window set up to adjust the [THRESHOLD TUNING] value to set a reasonable signal to noise threshold.
	Transmit Energy set too low	• Adjust transmit energy (transmit level, pulse width) to achieve LV pacing capture.

Issue Description	Possible Cause	Troubleshooting And Corrections
LV Pacing but not Synchronized to RV	Pulse widths not programmed correctly in co-implant	• Check and reprogram co-implant for correct pulse widths. Reinitialize Pacing Spike Detection.
	Noise being sensed as RV pacing spikes	• Investigate noise sources. Reinitialize Pacing Spike Detection.
	Temporary LVOO mode is active	• Check the operational mode with the Programmer.
	Pacing is synchronized to RA	• Check and reprogram co-implant for correct pulse widths. Reinitialize Pacing Spike Detection. • The most reliable detection operation is with RA pulse widths > 1.0 ms.
Inability to Command IPG to enter VOO Mode	Poor signal to noise ratio	Investigating noise sources such as: • Remove/ Disable potential interfering equipment: - Co-implant wand / wireless connection - Surface ECG - Potential other noise sources e.g., bed power supply • Optionally: - Change Room - Change orientation and position of radio module
No Communication Session can be Established with the Transmitter	Programmer Failure	• Re-boot Programmer to run self-test. Communicate with an alternative Transmitter to check functionality.
	Interference	• Arrange patient and radio module to improve the signal strength.
	Weak signal strength	• Check signal strength indicator. Arrange patient and radio module to improve the signal strength.
	Battery depleted	• Check patient records for device longevity history.
	Battery cable fractured or not connected	• X-ray devices and check for cable fracture.
Reduced Battery Life	Manual pacing parameters set too high	• Reprogram.
	Poor targeting	• Use acoustic window set up to adjust LOCATION SENSING electrodes, DISTANCE TARGET and DISTANCE LIMIT

Issue Description	Possible Cause	Troubleshooting And Corrections
No Marker Events	Communication link has stopped	• Check signal strength indicator. Arrange patient and radio module to improve the signal strength.
	Cable not connected to Programmer.	• Check that analog output cable is connected. Use the [CALIBRATE MARKER OUTPUT] feature in the Programmer setup.
	Transmitter programmed off – no pacing or sensing setup	• Check and reprogram Transmitter.
Communication Errors with the Transmitter	Interference or weak signal strength	• Arrange patient and radio module to improve the signal strength.

Issue Description	Possible Cause	Troubleshooting and Correction
Initializing RV Pacing Spike Detection with the Programmer fails	Co-implant not programmed for RV detectable pulse width above 0.35 ms.	• Program co-implant. Restart Pacing Spike Detection.
	Co-implant not pacing.	• Check and reprogram co-implant for mode and rates.
Acoustic Window Assessment Identifies Small Area	Transmitter or Electrode has moved.	• Use acoustic window set up to adjust use of Transmitter aperture. • If necessary, reposition Transmitter in pocket.
No Electrogram or Pacing with the Electrode Catheter	Connection to the Electrode is disconnected in the *Catheter* or the *Extension Cable* is not connected.	• Check connections. • Replace cable and retry. • Withdraw Delivery system and replace.
	Not connected to recording or pacing instruments	• Check connections from Catheter to equipment.

5 TECHNICAL SPECIFICATIONS

5.1 PHYSICAL AND ELECTRICAL SPECIFICATIONS

PHYSICAL SPECIFICATIONS	
Tablet Computer (H x W x T)	20.3 cm x 31.2 cm x 2.4 cm
Radio Module Footprint (W x L) / Height	7.4 cm x 9.4 cm/ 13.0 cm
Mass (Tablet / Radio Module)	1.3 kg/ 0.3 kg
Radio Module Cable Length	3.0 meters
AC/DC Power Adapter/ Cord Length	3.8 meters
Marker Events Cable Length	3.0 meters

ELECTRICAL SPECIFICATIONS	
AC Line Voltage	100-240 VAC
Power Input	1.6 A @ 100 VAC
AC Frequency	50/60 Hz
RF Reception Band	402-405 MHz (MICS/ MedRadio rules)
RF Transmission Bands	Frequency: 402.15 - 404.85 MHz (MICS/ MedRadio band) Modulation: 2-FSK @ 200 kbps Effective Radiated Power: -16 dBm maximum Frequency: 2.443 - 2.457 GHz (ISM band) Modulation: Manchester-encoded OOK (100%) Effective Radiated Power: + dBm maximum
DC Power Supply	Use only the AC power adapter provided with the Programmer to maintain electrical safety.

ENVIRONMENTAL SPECIFICATIONS	
Operating Temperature Range	59˚F to 95˚F
Storage Temperature Range	-22˚F to 140˚F
Operating Relative Humidity (maximum)	10% to 90% (non-condensing)
Operating Altitude	< 2000 meters

5.2 PARAMETER SPECIFICATIONS

SETUP PARAMETERS	Values/Range	Increments
Marker Output Level (mV)	10, 20, 50, 100, 200, 500, 1000	-----
Marker Output Pulse Width (ms)	1.0-20.0	1.0
Display Brightness	1-10	1

SETUP PARAMETERS	Values/Range	Increments
Speaker Volume	0-10	1

OPERATIONAL OUTPUT PARAMETERS	Range	Tolerance
Marker Output Level (mV)	10 - 1000	± 15 mV or ± 10%
Marker Output Pulse Width (ms)	1.0 - 20.0	0.1

5.3 TECHNICAL SERVICE AND SUPPORT

Warning: No modification of the Programmer is allowed except by authorized service personnel of EBR.

EBR installs the M5100 Programmer in the medical facility and when necessary EBR installs any new Software products that become available for the Programmer. Maintenance and service for the Programmer can only be performed by EBR. Should a Programmer require service it will be exchanged.

If the medical facility is required to perform safety checks at intervals specified by institutional regulations, they must be performed by persons, who, based on their training, knowledge, and practical experience, are capable of adequately performing such checks and who do not require instructions with regard to the safety checks.

Contact EBR in case of visual damage or issues with the Programmer M5100 operation.

5.4 CLEANING AND DISPOSAL OF DEVICES

The Programmer may be cleaned by wiping the exposed surfaces using isopropyl alcohol. The Programmer contains typical electronic components that require consideration for disposal. Return the Programmer to EBR or follow proper e-waste disposal procedures as recommended for personal computers.

Contact EBR to be supplied with materials related to returning devices for disposal.

5.5 SECURITY INFORMATION

The M5100 Programmer contains many security features as a way of ensuring device integrity and protecting patient data:

- **Connections**

  The Programmer is not intended to operate in any network environment, including the internet.

- **Maintenance USB Dongles**

  EBR authorized USB dongles required for maintenance shall be distributed to EBR Authorized Personnel when needed. These should be controlled to prevent the possible spread of malware.

- **Patient Data Storage**

  There is limited storage for patient data on the Programmer. Any patient data needing to be retrieved should be retrieved during or at the end of the session with the patient.

- **Security User Actions**

In the event the Programmer detects a possible cybersecurity threat, the Programmer will show a security badge icon (**Figure 29**) to alert the user to a possible security threat. The red badge can be clicked on to show a dialog with more information regarding the possible security threat including the following:

- Unauthorized network detected
- Unauthorized access to Transmitter attempted
- Unexpected Transmitter radio activity

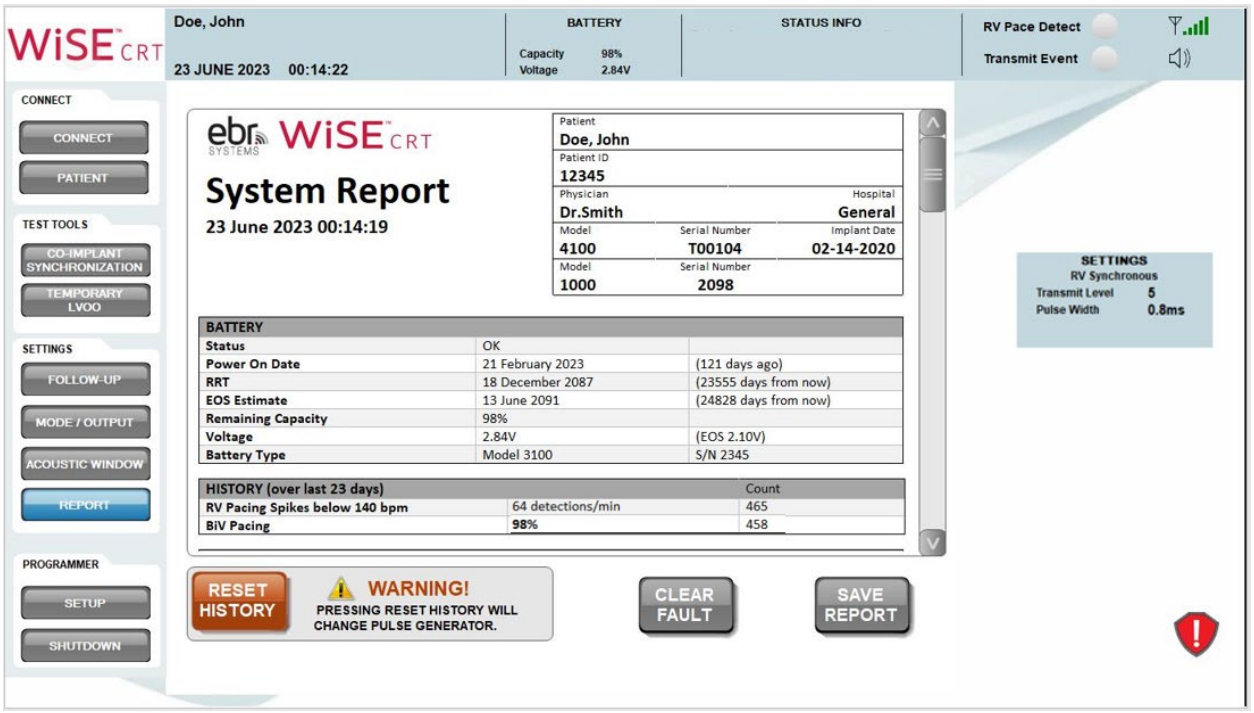


Figure 29. Programmer Screen with Security Badge Icon

If you see the red security badge (shown in lower right corner in Figure 29) icon or suspect any other security threat, then please contact your EBR Representative without delay.

- **Access Prevention**

  The tablet computer is configured to prevent unauthorized access to the internal operating system via hardening, password protection, and EBR authorized USB dongles.

- **Authenticated Software Upgrade**

  Upgrading Programmer software or using the Programmer to upgrade Transmitter software requires upgrade software authenticated by EBR. Upgrade software not authenticated by EBR will not be accepted.

- **Application of Software Patches and Upgrades**

  Apply software patches and/or WiSE CRT software upgrades per the manufacturer's instruction.

- **Encryption of Patient Information**

For the communication link between the Programmer and Transmitter, the Transmitter prevents unauthorized communication and programming, and the Programmer encrypts all patient identifying information.

- **Physical Controls**

  EBR encourages healthcare providers to have secure physical controls over the Programmer to limit Programmer access to authorized personnel.

5.6 EMC INFORMATION

This device complies with part 15 of the Federal Communications Commission (FCC) Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Warning: The Programmer should not be used adjacent to or stacked with other equipment because it could result in improper operation. If adjacent or stacked use is necessary, the Programmer should be observed to verify normal operation in the configuration in which it will be used.

Warning: The Programmer may be interfered with by other equipment, even if that other equipment complies with the CISPR emission requirements.

Warning: Use of accessories, transducers, and cables other than those specified or provided could result in increased electromagnetic emissions or decreased electromagnetic immunity of the Programmer and result in improper operation.

Warning: Portable RF communications equipment (including peripherals such as antenna cables and external antennas) should be used not closer than 30 cm (12 inches) to any part of the Programmer, including cables specified for use with the Programmer. Otherwise, degradation of the performance of this equipment could result.

Note: “Harmful interference” is defined in 47 CFR §2.1 by the FCC as follows: Interference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radio communication service operating in accordance with the [ITU] Radio Regulations.

See M5100 product label for specific FCC ID number for your Programmer.

The essential performance of the Programmer M5100 is the ability to power off the Programmer and the ability to communicate with a Pulse Generator and display a report.

Guidance and Manufacturer’s Declaration – Classification of ME Equipment and ME Systems
IEC 60601-1 Clause 6: The Programmer M5100 is Class II ME Equipment, with no applied parts.

Guidance and Manufacturer's Declaration – Electromagnetic Emissions		
The Programmer M5100 is intended for use in the electromagnetic environment specified below. The operator of the Programmer M5100 should assure that it is used in such an environment.		
Emissions test	**Compliance**	**Electromagnetic environment - guidance**
RF Emissions CISPR 11	Group 1	The Programmer M5100 must emit electromagnetic energy in order to perform its intended function. Nearby electronic equipment may be affected.
RF Emissions CISPR 11	Class B	The Programmer M5100 is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic Emissions IEC 61000-3-2	Class A	
Voltage Fluctuations/ Flicker Emissions IEC 61000-3-3	Complies	

Guidance and Manufacturer's Declaration – Electromagnetic Immunity			
The Programmer M5100 is intended for use in the electromagnetic environment specified below. The operator of the Programmer M5100 should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Electrostatic Discharge (ESD) IEC 61000-4-2	± 8 kV contact ± 15 kV air	± 8 kV contact ± 15 kV air	Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical Fast Transient/ Burst IEC 61000-4-4	± 2 kV for power supply lines ± 1 kV for input/ output lines	± 2 kV for power supply lines ± 1 kV for input/ output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	± 1 kV line(s) to line(s) ± 2 kV line(s) to earth	± 1 kV line(s) to line(s) ± 2 kV line(s) to earth	Mains power quality should be that of a typical commercial or hospital environment.
Voltage Dips, Short Interruptions and Voltage Variations on Power Supply Input Lines	> 95%, 0.5 Cycles 60% 5 Cycles 30%, 25 Cycles > 95%, 250 cycles	> 95%, 0.5 Cycles 60% 5 Cycles 30%, 25 Cycles > 95%, 250 cycles	Mains power quality should be that of a typical commercial or hospital environment. If the use of the Programmer M5100 requires continued operation during power mains interruptions, it is recommended that the

Guidance and Manufacturer's Declaration – Electromagnetic Immunity			
IEC 61000-4-11			Programmer M5100 be powered from an uninterruptible power supply.
Power Frequency (50/60 Hz) Magnetic Field IEC 61000-4-8	30 A/m	30 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Note: U_T is the a.c. mains voltage prior to application of the test level.			

Guidance and Manufacturer's Declaration – Electromagnetic Immunity			
The Programmer M5100 is intended for use in the electromagnetic environment specified below. The operator of the Programmer M5100 should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Conducted RF **IEC 61000-4-6** **Radiated RF** **IEC 61000-4-3**	3 Vrms 150 kHz to 80 MHz 3 V/m 80 MHz to 2.5 GHz	3 Vrms 3 V/m	Portable and mobile RF communications equipment should be used no closer to any part of the M5100 Programmer, including cable, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance** $d = 1.2\sqrt{P}$ $d = 1.2\sqrt{P}$ 80 MHz to 800 MHz $d = 2.3\sqrt{P}$ 800 MHz to 2.5 GHz where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey[a], should be less than the compliance level in each frequency range[b]. Interference may occur in the vicinity of equipment marked with the following symbol: 
Note 1 At 80 MHz and 800 MHz, the higher frequency range applies.			

Note 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

[a] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the Programmer M5100 is used exceeds the applicable RF compliance levels above, the Programmer M5100 should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the Programmer M5100.

[b] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

Recommended Separation Distances between Portable and Mobile RF Communications Equipment and the Programmer M5100

The Programmer M5100 is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The operator of the Programmer M5100 can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the Programmer M5100 as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter (W)	**Separation distance according to frequency of transmitter (m)**		
	150 kHz to 80 MHz $d = 1.2\sqrt{P}$	**80 MHz to 800 MHz** $d = 1.2\sqrt{P}$	**800 MHz to 2,5 GHz** $d = 2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

For transmitters rated at a maximum output power not listed above, the recommended separation distance *d* in meters can be estimated using the equation applicable to the frequency of the transmitter, where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

Note 1 At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

Note 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

6 SYMBOL GLOSSARY

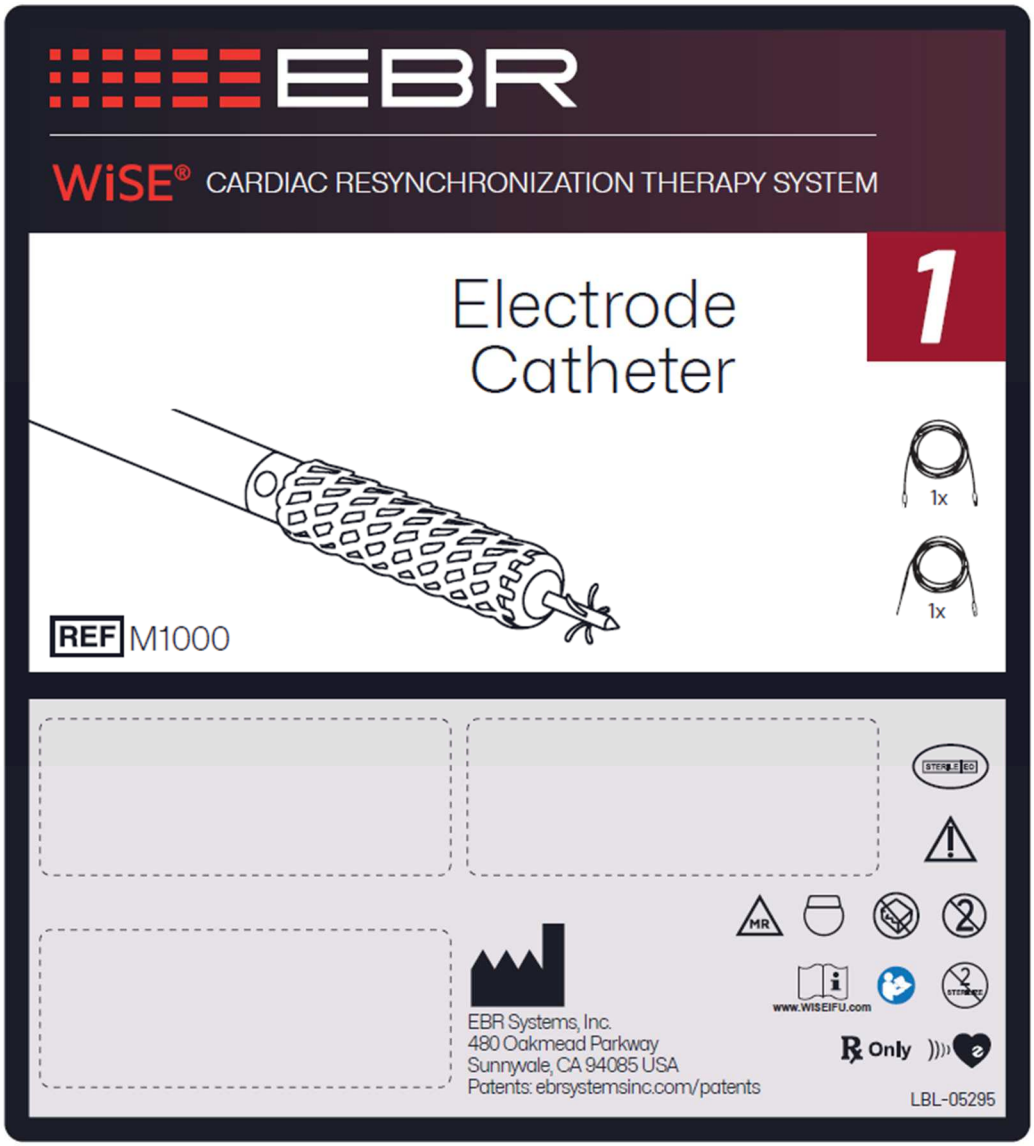
Refer to the Common Section IFU (LBL-05300) for an explanation of the symbols found on the product or the product label for the Programmer (M5100) of the WiSE CRT System.

EBR	**TITLE:**	**WiSE CRT M1000 Shelf Carton Label**
	TYPE:	**LBL**

Attachment A: Label Content and Artwork

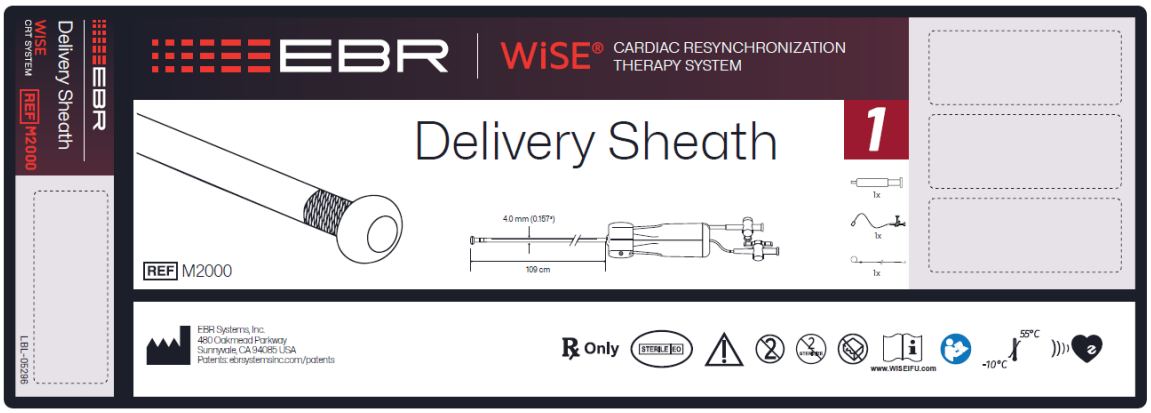
EBR	TITLE:	WiSE CRT M1000 Sterile Barrier Label
	TYPE:	LBL

Attachment A: Label Content and Artwork



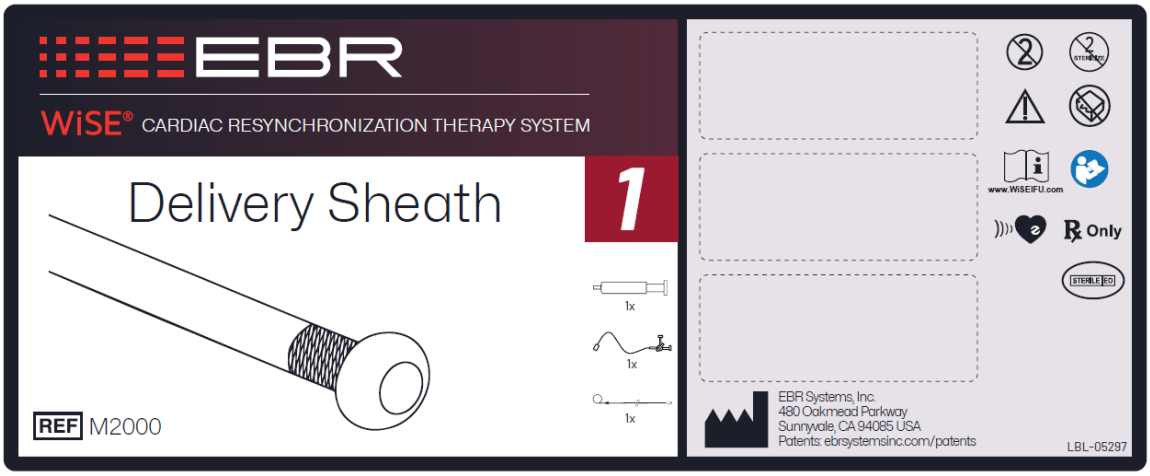
EBR	**TITLE:**	**WiSE CRT M2000 Shelf Carton Label**
	TYPE:	**LBL**

Attachment A: Label Content and Artwork



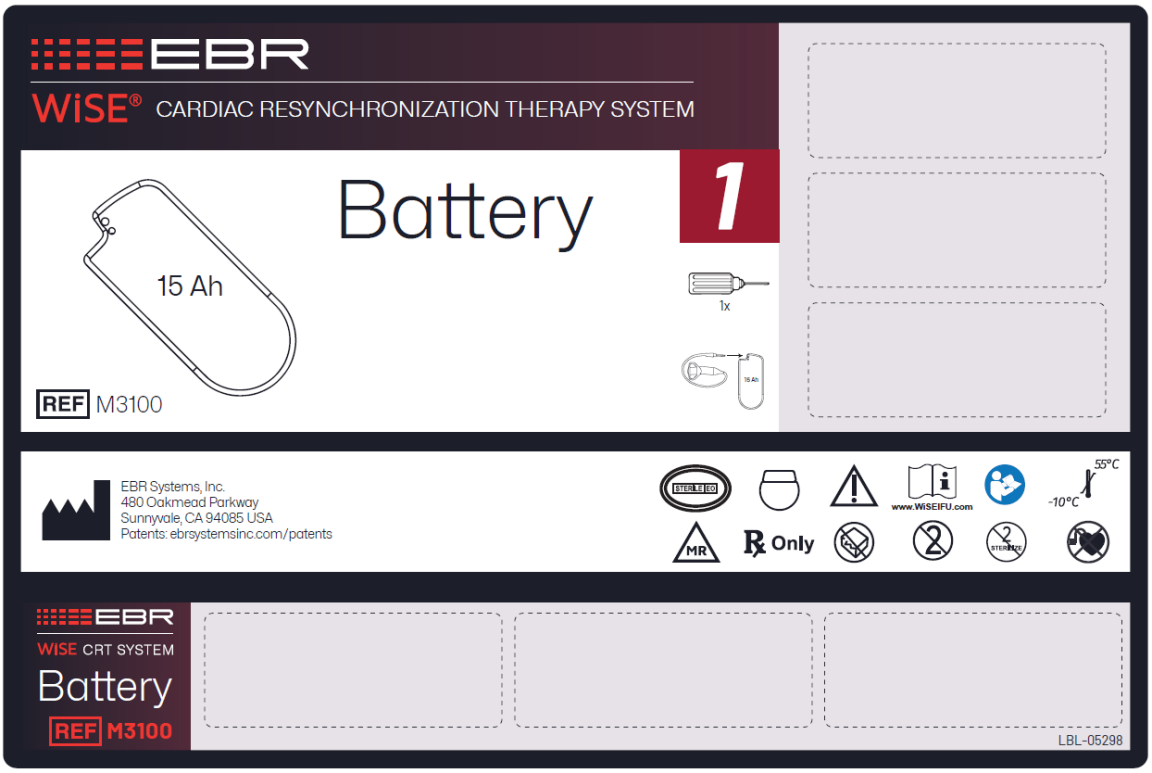
EBR	**TITLE:**	**WiSE CRT M2000 Sterile Barrier Label**
	TYPE:	**LBL**

Attachment A: Label Content and Artwork



EBR	**TITLE:**	**WiSE CRT M3100 Shelf Carton Label**
	TYPE:	**LBL**

Attachment A: Label Content and Artwork

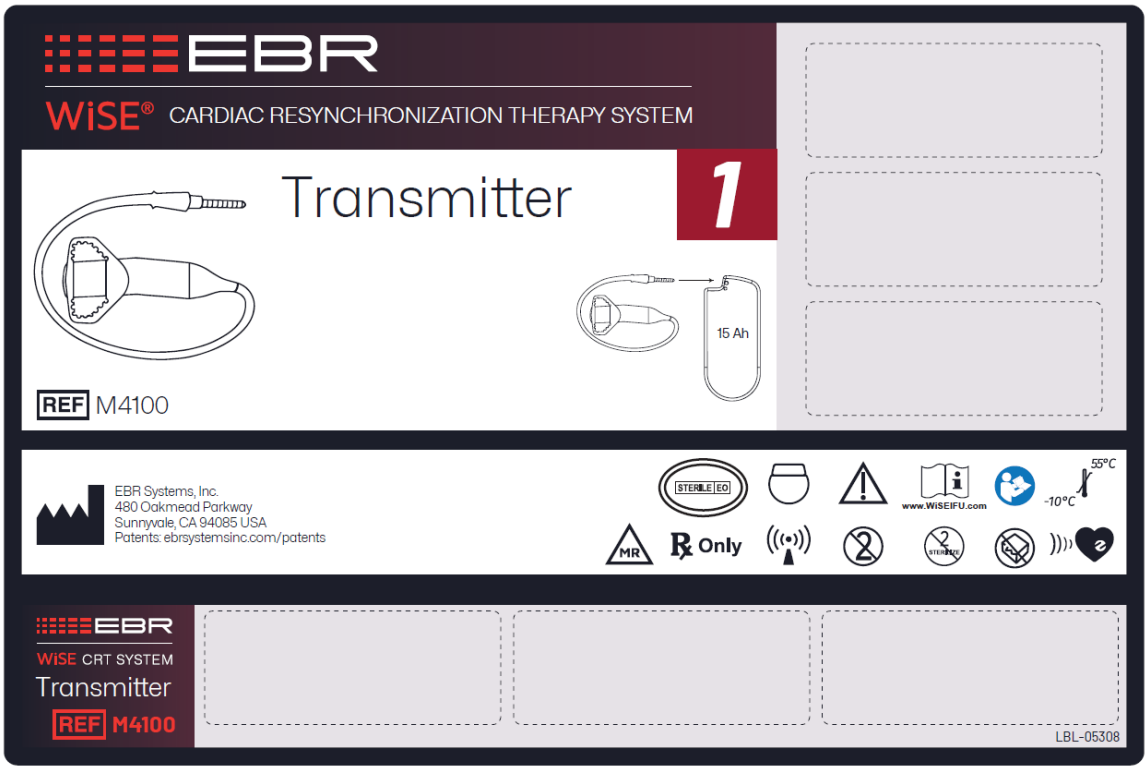


EBR	TITLE:	WiSE CRT M3100 Sterile Barrier Label
	TYPE:	LBL

Attachment A: Label Content and Artwork

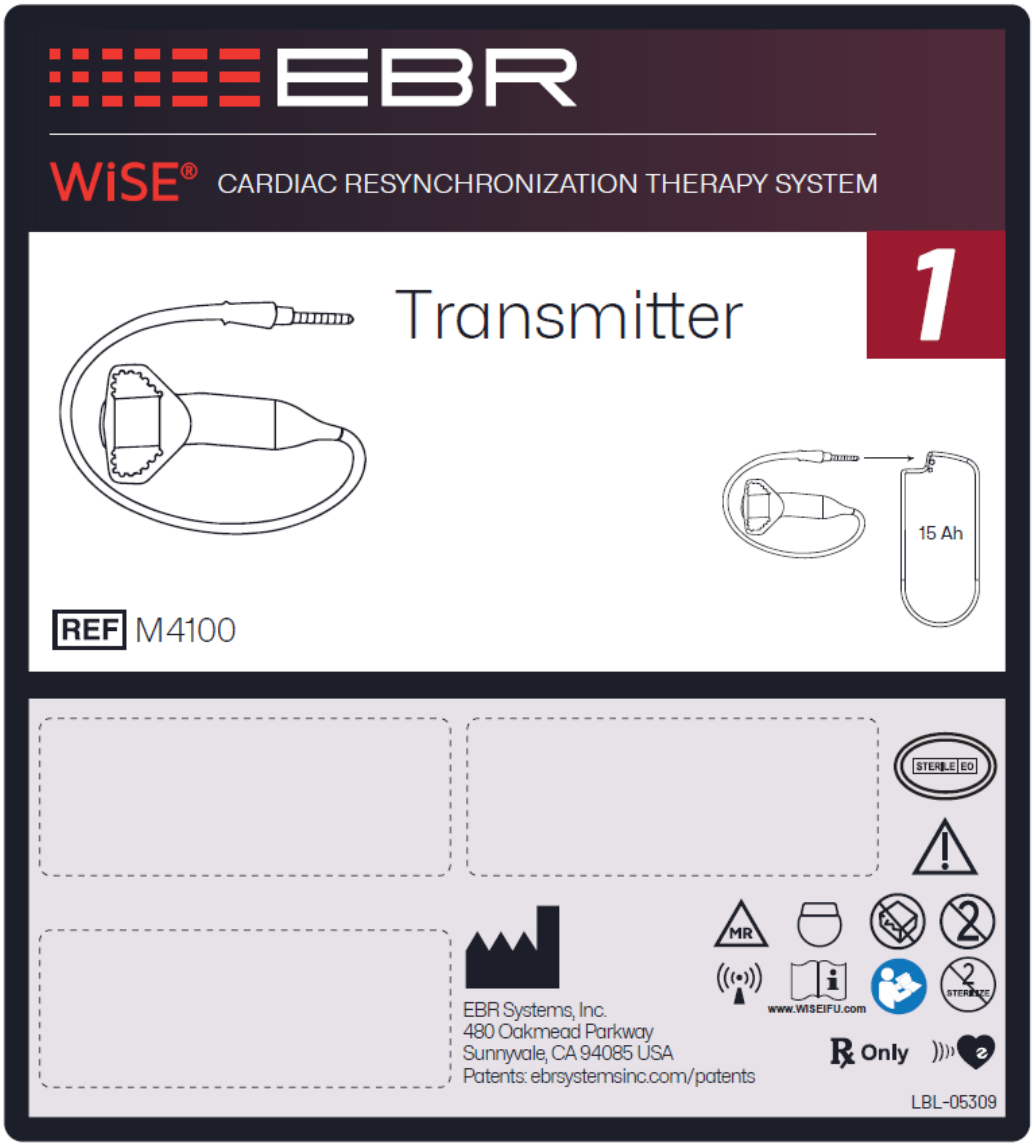
EBR	TITLE:	WiSE CRT M4100 Shelf Carton Label
	TYPE:	LBL

Attachment A: Label Content and Artwork



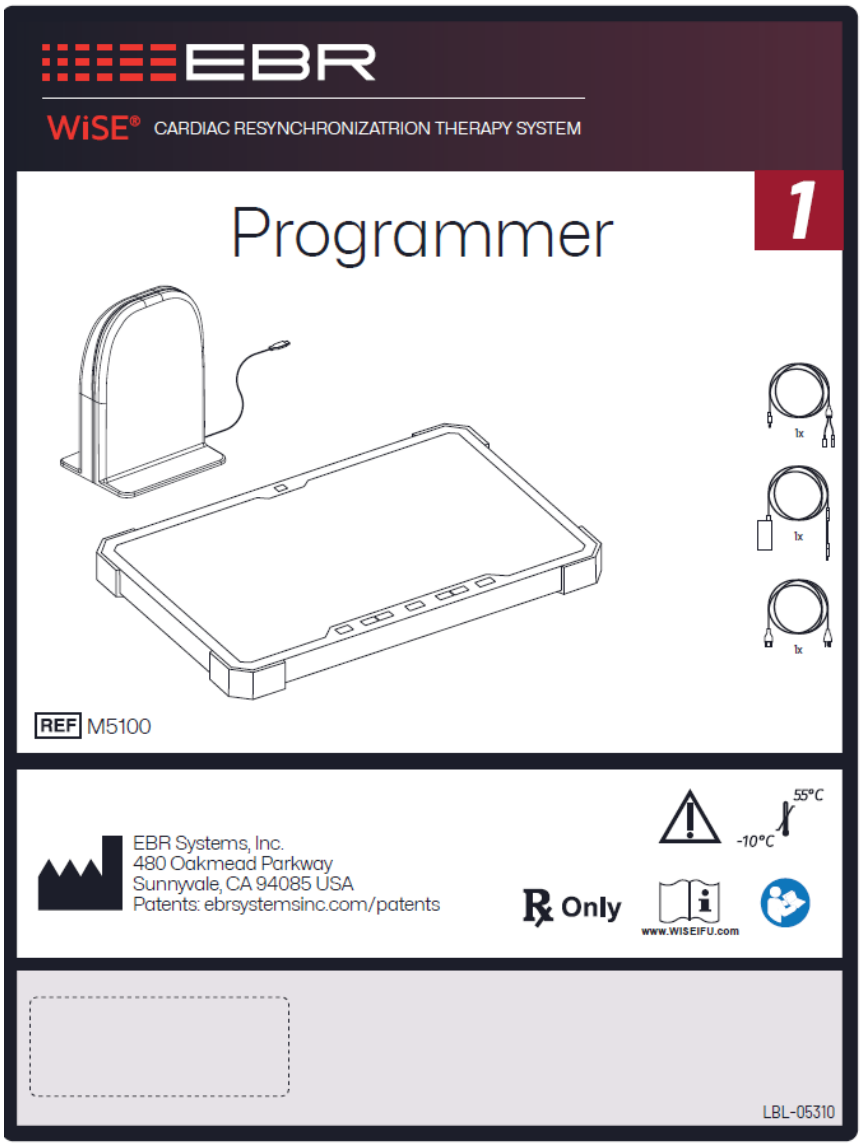
EBR	TITLE:	WiSE CRT M4100 Sterile Barrier Label
	TYPE:	LBL

Attachment A: Label Content and Artwork



EBR	TITLE:	WiSE CRT M5100 Case Label
	TYPE:	LBL

Attachment A: Label Content and Artwork



EBR	TITLE:	WiSE CRT M5100 Tablet Label
	TYPE:	LBL

Attachment A: Label Content and Artwork

EBR	TITLE:	WiSE CRT M5100 RIO Foot Label
	TYPE:	LBL

Attachment A: Label Content and Artwork

EBR	TITLE:	Label, RIO Side
	TYPE:	LBL

Attachment A: Label Content and Artwork

EBR	TITLE:	Label, Case Badge
	TYPE:	LBL

Attachment A: Label Content and Artwork

WiSE® Cardiac Resynchronization Therapy (CRT) System

INSTRUCTIONS FOR USE

Battery and Transmitter

For use with:

- **WiSE CRT Battery (M3100)**
- **WiSE CRT Transmitter (M4100)**

EBR Systems, Inc.
480 Oakmead Parkway
Sunnyvale, CA 94085 USA
www.ebrsystemsinc.com
+1 408 720 1906
support@ebrsystemsinc.com

LBL-05302 Rev. 02 DRAFT

Table of Contents

1 REQUIRED SUPPLIES AND EQUIPMENT

FOR THIS SCREENING PROCEDURE (Section 3), YOU NEED:

- Echocardiographic imaging system equipped with a linear (vascular) probe and cardiac probe
- Ribbon tape measure
- Surgical marker pen
- Acoustic Window Screening Form (**Section 6**)

FOR THIS IMPLANT PROCEDURE (Section 4), YOU NEED:

- Transmitter M4100 (Model 4100)
- Battery M3100 (Model 3100)
- Programmer M5100 (Model 5100) with compatible software
- Surgical tools including:
    - Small retractor
    - Tunneling tool
    - Dilator
    - Spreader
    - Needle holder
- Routing tube (approximately 18" length x 0.375" (9.5 mm) diameter)
- Transmitter sutures (non-absorbable sutures, 2.0 braided or non-braided with a tapercut needle)
- Battery sutures (non-absorbable 2.0 sutures)
- Ribbon tape measure
- Surgical marker pen
- Echocardiographic imaging system equipped with a linear (vascular) probe and cardiac probe. Also to include a sterile sleeve and ultrasound gel for in-pocket imaging with the cardiac probe.
- Completed Acoustic Window Screening Form (**Section 6**)

2 PRECAUTIONS

For use only by Qualified Medical Personnel in professional healthcare environments: The WiSE CRT System is intended to be used by qualified cardiologist physicians and only in professional healthcare facilities. EBR provides both hands-on preclinical training and didactic training. Before using the system, contact EBR to schedule a training session for implant operators. Obtaining proper surgical training and technique is the responsibility of the implanting physician. At least annually, review didactic training materials supplied and presented by support personnel from EBR. Obtaining this training prior to implant procedures is the responsibility of the implanting physician. A didactic refresher session is recommended prior to an implant. The information provided in these Instructions for Use (IFU) and in the

Common Section WiSE CRT System IFU should be considered as a required supplement for qualified and experienced medical professionals.

2.1 STERILE SINGLE USE DEVICES

- The WiSE CRT Transmitter and Battery are sterilized via ethylene oxide gas processes after being packaged. Return any package to EBR that does not appear to present a sterile barrier.
- The WiSE CRT Transmitter and Battery are for SINGLE USE only. Do not attempt to sterilize and reuse any implantable WiSE CRT device if it has previously been implanted in another patient.

2.2 STORAGE AND HANDLING

- Devices should be stored in their original packages in a dry, clean environment.
- Allow devices to acclimate to room temperature prior to implanting.

2.3 CO-IMPLANTED PACEMAKER, DEFIBRILLATOR, OR BIVENTRICULAR DEVICE COMPATIBILITY

- The WiSE CRT System is intended to be used to provide biventricular (BiV) pacing (BiVP) in conjunction with a co-implanted pacemaker (including leadless Micra™ pacemakers), defibrillator, or BiV pacing device. Program the co-implanted device to deliver right ventricular (RV) pacing in the appropriate mode and timing interval settings as would be required for CRT.
- Specific capabilities and features of the co-implanted device must be reviewed against criteria described in **Section 3.2** of this IFU. These instructions must be reviewed prior to implanting the WiSE CRT Transmitter.

  Note: Anti-tachy therapies should be adjusted for the use of electrocautery during the implant procedure (**Section 4**).

2.4 PRE-IMPLANT DEVICE CHECKING

- Check the device package for the expiry date/ ”use-by” date. Do not use devices which are past the expiry date/ ”use-by” date marked on the package.
- Inspect the device package for damage. Do not use the device if the packaging has been damaged, the seals have been opened, or the packaging is wet. Return any package to EBR that does not appear to present a sterile barrier.
- Check the package contents against the content list of the label. Do not use the device if all listed components are not present in the package.
- Check that a pre-implant transthoracic echocardiogram (TTE) procedure was completed, that the acoustic window was documented, and that the information is available for selecting the implant location for the Transmitter.

2.5 IMPLANT PROCEDURE

The following are important considerations for the implant procedure:

- To reduce the risk of excessive bleeding, check the patient’s coagulation status prior to implantation.

- Patients should have an external defibrillator and ECG attached.

  Note: Do not directly place defibrillation pads over the Transmitter or Battery implant sites.
- Do not damage / cut the Transmitter cable. Use fingers to grip the cable connector and insert it into the Battery connector/ header block; do not use any instruments to hold or insert the cable into the Battery header.
- Do not kink the cable during handling or during implant.
- Do not leave a sharp bend radius in the cable implant.
- Do not allow the cable connector to become wet.
- Careful dissection and blunt force tunneling is required to avoid risk of perforation of the intercostal muscle and into the thoracic cavity.

2.6 PROGRAMMING

- Use only the EBR Programmer to attempt to communicate with and program the WiSE CRT System.

2.7 EXPLANT AND DISPOSAL

- Program the WiSE CRT System operational mode to OFF prior to explant.
- Return all explanted devices to EBR Systems to assist with full life-cycle device traceability and to ensure safe and environmentally sensitive disposal.
- Clean and disinfect WiSE CRT devices prior to sending to EBR.

3 PRIOR TO IMPLANTING THE TRANSMITTER

3.1 ASSESSING THE ACOUSTIC WINDOW

An acoustic window is commonly known in echocardiography as the location where a cardiac probe is placed to view the heart. The term “window” refers to a lung-free, cartilage-free pathway for ultrasound to travel between the probe and the heart. Both air-filled lung tissue and cartilage may impede the transmission of the ultrasound signal to the LV electrode, and that lung encroachment may occur with respiration and with posture.

The WiSE CRT Transmitter sends ultrasonic pulses through the chest wall to the Electrode in the heart and thus must be implanted in an adequate acoustic window (at least 1 cm spacing between ribs[1] by 2.5 cm in length) for transmission of ultrasound. This window is typically in the 4th, 5th, or 6th intercostal space (ICS), lateral to the left sternal border (**Figure 1**).

[1] The term rib is used rather than costal cartilage because the Transmitter can be implanted medial to or within the transition from true rib bone to costal cartilage. This transition occurs roughly at the location of the nipple.

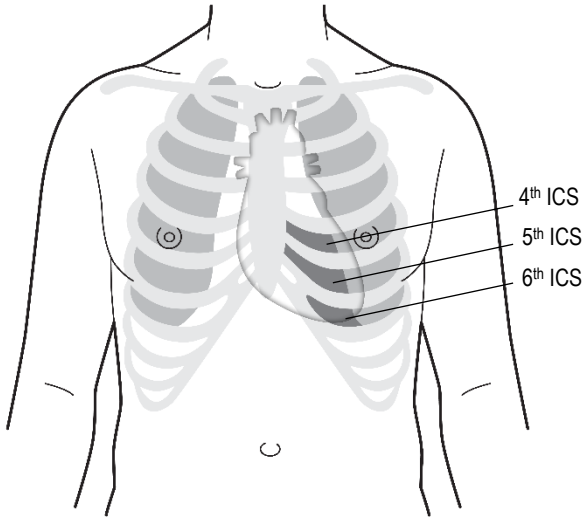


Figure 1. Typical Acoustic Window Options for Transmitter Implant

A screening procedure to confirm the existence of an adequately sized acoustic window must be performed prior to the Transmitter implant procedure. This screening is performed using a commercially available echocardiographic imaging system equipped with a TTE probe and a linear (vascular) probe. The linear (vascular) probe is required to accurately identify the location and spacing of the ribs. The cardiac probe is used to visualize the location (distance and angle) of target Electrode implant sites relative to candidate Transmitter implant sites. It is also used to identify the point along the ICS where lung encroachment occurs. This screening procedure can be performed as an adjunct to standard echocardiography, routinely performed prior to CRT implantation.

The location of the lungs changes with patient movement and respiration. Consequently, the screening is performed in multiple body positions to ensure an adequate acoustic window in all postures.

SCREENING PROCEDURE STEPS:

1. Start with the patient in supine posture.
2. Mark the center line of the sternum.
3. Identify and mark the location of the 4^{th}-7^{th} ribs. Start at the sternal angle (angle of Louis) with the long axis of the linear (vascular) probe oriented in the superior-inferior patient plane with the indicator mark oriented toward the patient's head, or at 12 o'clock, and slide the probe lateral to identify and mark the nearest rib. Slide the probe superiorly to the clavicle and 1^{st} rib and continue inferiorly until the 4^{th}–7^{th} ribs are visualized. Identify and mark the 6^{th} and 7^{th} co-joint to determine accurate counting of the ribs and ICSs (**Figure 2**).

   Note: There is commonly a narrowing and/or conjoining of the 6^{th} and 7^{th} rib approximately 4-8 cm from the mid sternal line. Appreciation of this anatomical landmark can avoid confusion during the screening procedure and can be useful as an anatomical reference point.

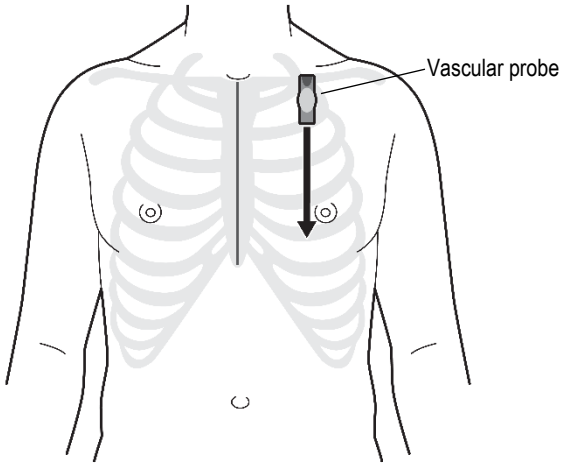


Figure 2. Identification of Location of 4th – 7th Ribs

4. Place the probe over the 4th rib mark and while maintaining the superior-inferior orientation of the probe, slowly slide the linear (vascular) probe from medial to lateral keeping the 4th rib centered in the image. Use this technique to determine and mark the medial-lateral course of the 4th rib (e.g., straight vs. curved inferior vs. curved superior) from sternal border out to 6 cm laterally in length. Mark the centerline of the 4th rib (**Figure 3**).

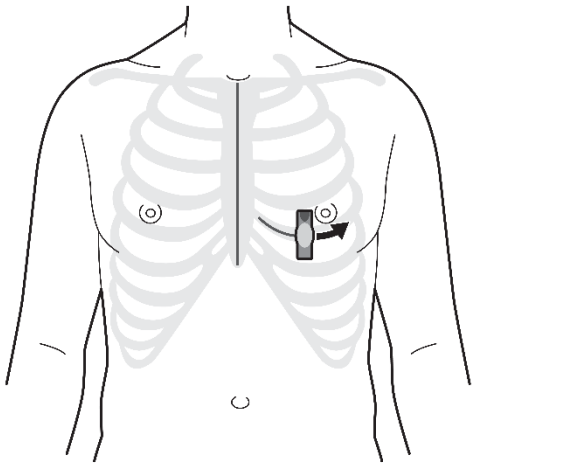


Figure 3. Determination and Marking of Medial Lateral Course of 4th - 7th Ribs

5. Move the linear (vascular) probe down to the 5th rib and repeat sliding the probe medial-lateral to determine and mark the centerline of the 5th rib.
6. Move the linear (vascular) probe down to the 6th rib and repeat sliding the probe medial-lateral to determine and mark the centerline of the 6th rib.
7. While maintaining the linear (vascular) probe over the 6th rib, slide the probe far lateral of the mid sternal line prior to moving the probe down to the 7th rib. This is important to avoid any confusion from the potential conjoining of the 6th and 7th ribs. Move the probe down to the 7th rib and repeat sliding the probe medial-lateral to determine and mark the location of the 7th rib.

8. As an anatomical reference point, measure, and record on the screening form the length from the suprasternal notch down to mid-4th, 5th, and 6th ICSs.

9. Based on the marks for the 4th and 5th ribs, place the linear (vascular) probe oriented in a superior-inferior patient plane centered between the marks. Starting at the sternum slowly slide the linear (vascular) probe along the centerline of the 4th ICS. Make sure that the probe is oriented perpendicular to the centerline and ribs. Determine where the spacing between the ribs open to 1 cm in width at the narrowest region between the ribs. Mark this location on the patient's chest with a vertical line spanning between the 4th and 5th rib lines **(Figure 4**).

   Note: If the spacing between the ribs does not open to greater than ≥ 1 cm, the ICS is not adequate and should not be used.

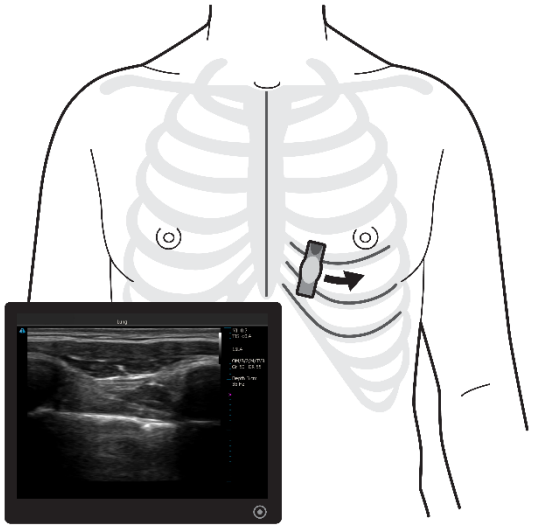


Figure 4. Marking, with Ultrasound Assistance, where 4th – 6th ICSs Open to 1 cm in Width
The ultrasound image example displays the ribs and the 5th ICS which can used to determine the location where the spacing between the ribs open to 1 cm.

10. With the probe on the 1 cm width ICS mark, measure the adipose thickness from the top of the image sector to the top of the rib plane over the ICS. Take care not to apply pressure to the probe when performing the adipose thickness measurement as this can compress the tissue and produce an inaccurate measurement (**Figure 5**).

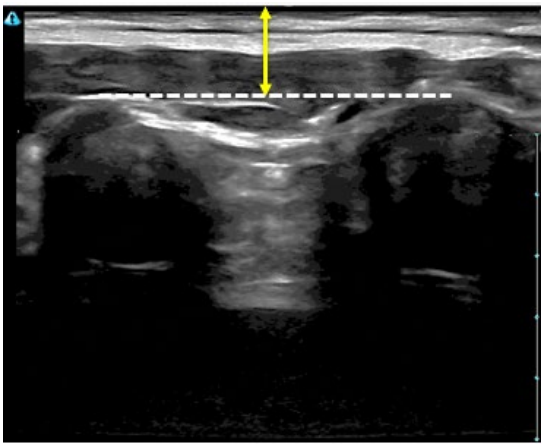


Figure 5. Adipose Thickness Measurement
Image shows the distance from the top of the image sector (chest wall) to the top of the ribs (yellow arrow) centered over the ICS at the level of the top of the rib plane (dotted white line).

11. Continue sliding laterally along the centerline of the 4th ICS for approximately 6 cm to ensure that a 1 cm spacing is maintained. If there is any narrowing to less than 1 cm over this distance, the ICS is not adequate and should not be used.

12. Repeat Steps 8-10 for the 5th and 6th ICS. However, for the 6th ICS, instead of starting the process at the sternum, start the process lateral to the co-joint of the 6th and 7th ribs (**Figure 6**).

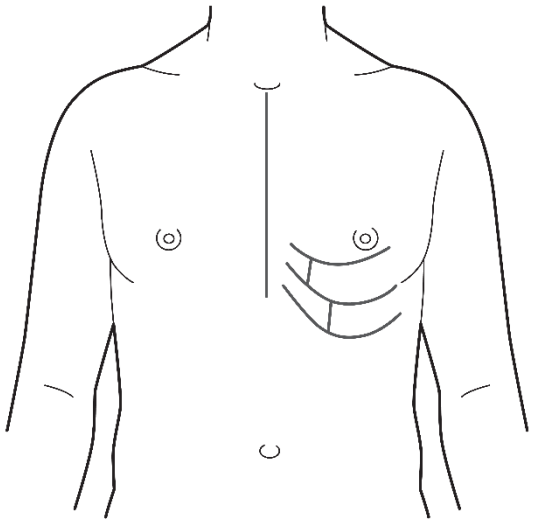


Figure 6. Marking where the 6th ICS Opens to 1 cm Lateral to the Co-Joint and Ensuring the 1 cm Spacing is Maintained along the ICS.

13. Switch over to the cardiac probe.

14. Determine the area of ICS that is free of lung encroachment and mark accordingly.

14A. Place the probe in the 4th ICS lateral to the 1 cm opening mark. Orient the probe with the indicator mark pointed towards the patient's sternum, or at 9 o'clock, with the fan beam parallel to the ICS with 0° of probe angulation (**Figure 7**).

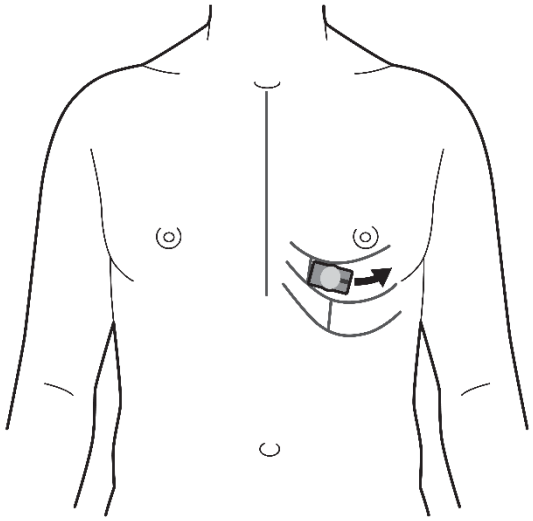


Figure 7. Orienting Probe so the Fan Beam is Parallel with the Direction of the ICS

14B. Angle the probe to visualize the target implant site heart walls.

14C. While requesting the patient to mimic moderate but not deep inhalation, hold the probe in place and observe the ultrasound image for the presence of lung encroachment. This is typically evidenced by a white hyperechoic reflective shadow encroaching over a part of or the entire ultrasound image of the heart. Lung encroachment artifact can swing in and out of the acoustic window echocardiography plane during respiration (**Figure 8**).

14D. If there is encroachment seen on initial placement of the probe just lateral to the 1 cm line, the ICS acoustic window length is too short (< 2.5 cm). No further measurements of the ICS are required.

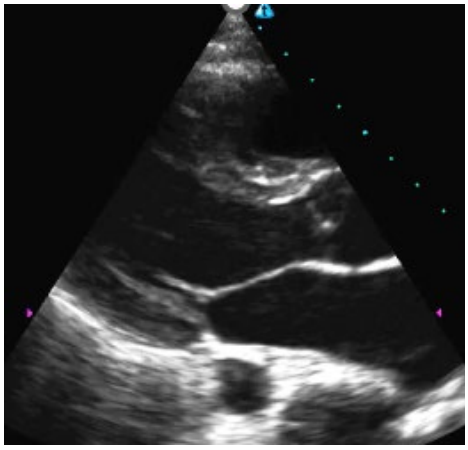
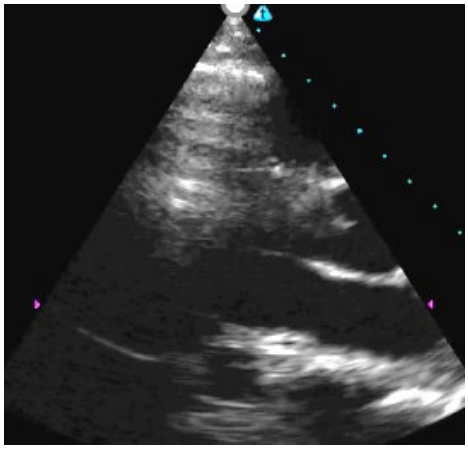
a.  b. 

Figure 8. Echocardiographic Image without Reflection Artifact from Lunch Encroachment during Exhalation

(a) and echo image with reflection artifact from lung encroachment (annotated L) during inhalation, approaching from the direction of the left ventricular apex and over the mid and basal segments of the left ventricular walls (b).

14E. If no encroachment is seen on initial placement, slowly move the probe along the centerline of the ICS until the first sign of lung encroachment is seen (**Figure 9**).

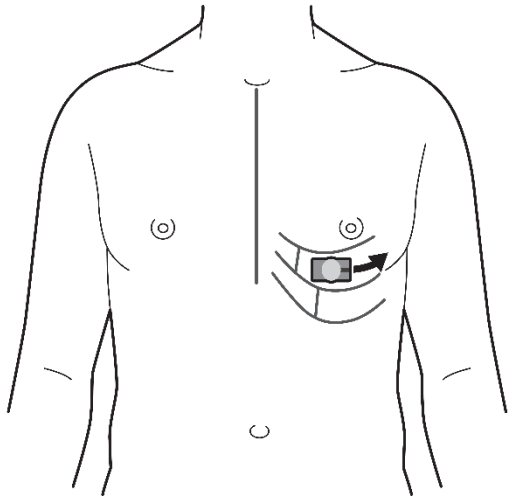


Figure 9. Moving Probe along ICS Centerline until Lung Encroachment is Seen

14F. Once lung encroachment is seen, mark the location of the lateral border of the probe with a line extending between the upper and lower rib lines (**Figure 10**).

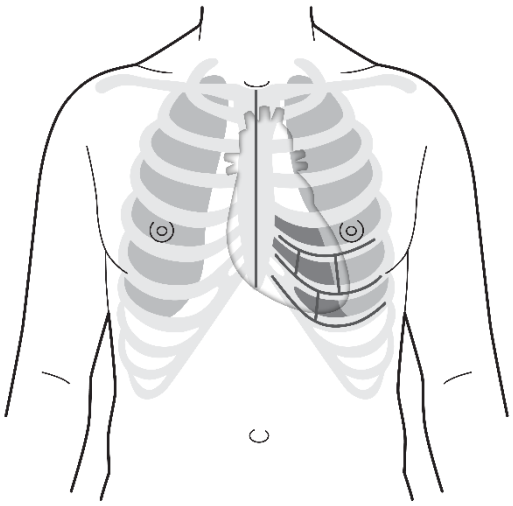


Figure 10. Marking Lung Border of 4th, 5th, and 6th ICS Acoustic Windows

15. Repeat Step 14 for the 5th and 6th ICSs.

16. Perform Steps 14 and 15 with the patient in the following postures:

- Supine
- Laying on right side
- Sitting or standing

Note: The location of lung encroachment can vary depending on the patient's posture. Additional marking is required if the measured length where the lung encroachment is seen is smaller in other postures than previously marked.

17. For the ICS spaces with sufficient length ≥ 2.5 cm, estimate the angulation and distance to potential implant sites for the Electrode.

17A. Place the cardiac probe over the potential site for Transmitter implantation. The probe should be oriented with the indicator mark pointed towards the patient's sternum, or at 9 o'clock, and the fan beam parallel with the direction of the ICS with 0° probe angulation (**Figure 11**).

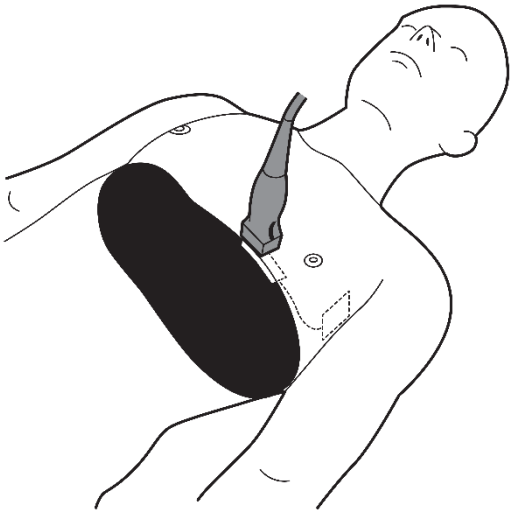


Figure 11. Placing Cardiac Probe over Potential Site for Transmitter Implantation

17B. Using the cardiac probe as a proxy for the Transmitter once implanted, hold the probe at the estimated medial-lateral angle that the Transmitter would naturally lay once implanted.

17C. While maintaining the medial-lateral angle of the probe in the Step 17B, adjust the cranial-caudal angle of the probe to visualize the targeted Electrode implant sites on the left ventricular (LV) wall in the ultrasound image. Estimate the cranial-caudal angle from the angulation of the probe perpendicular to the chest, where the targeted Electrode implant sites on the LV walls are visible. Cranial-caudal angulation of the probe can also be referenced as anterior-posterior angulation, which describes a scanning maneuver within echocardiographic nomenclature (**Figure 12**).

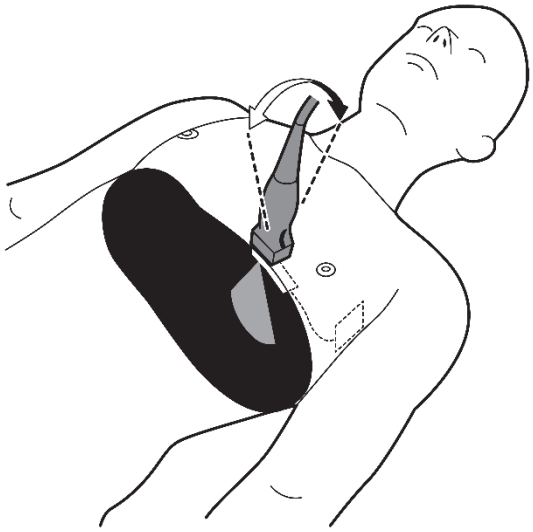


Figure 12. Adjusting Cranial-Caudal Angle of Probe to Visualize Targeted Electrode Implant Site

17D. Holding the probe at the medial-lateral and cranial-caudal angles to the skin/ chest as noted in Steps 17A through 17C, estimate the medial-lateral angle on the echocardiographic image to the candidate Electrode implant site. Draw a centerline on the echocardiographic image sector and measure the distance in the echocardiographic image from the approximate location of the anterior surface of the ICS (top of image sector) to the candidate Electrode implant site of interest. Estimate the medial-lateral angles from each distance measurement in relation to the echocardiographic image centerline(**Figure 13**).

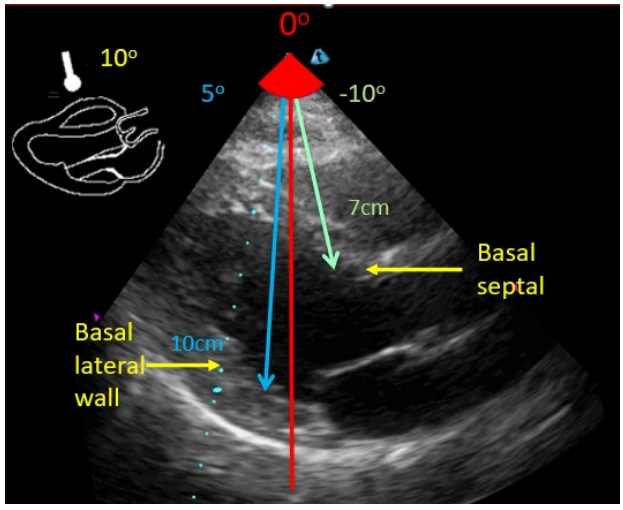


Figure 13. Measuring Distance to Electrode Implant Site of Interest

17E. Record the following data for each candidate ICS on the screening form:

- Distance horizontally from mid sternal line to 1 cm spacing between the ribs
- Distance vertically from suprasternal notch to mid-4th, 5th, and 6th ICS

- ICS length, shortest distance (across different postures) from 1 cm spacing between the ribs to point of lung encroachment
- Adipose thickness measurement
- Location of identified potential Electrode implant site
- Left ventricular wall thickness (Note: In the targeted Electrode implant site the minimum LV wall thickness must be at least 5 mm.)
- Estimated medial-lateral angle to candidate Electrode implant site
- Estimated cranial-caudal angle to candidate Electrode implant site
- Distance to candidate Electrode implant site

Note: When multiple acoustic windows are available for WiSE CRT Transmitter implantation, the window with nominal transmission values (ICS dimensions, distance, and angle between the Transmitter and Electrode) and the longest acoustic window length should always be selected. For optimal transmission, the distance should be 10 cm or less with a transmission angle (combined medial-lateral angle and cranial-caudal angle) of 30° or less. Positioning the Transmitter as medial as possible minimizes the possibility of reduced performance due to lung encroachment and should always be a primary objective, regardless of the acoustic window selected.

Note: To confirm the Transmitter implantation site, a shortened version of the screening process must be repeated at the start of the Transmitter and Battery implant procedure before sterile preparation of the patient (**Section 4**).

3.2 CONSIDERATIONS FOR THE CO-IMPLANT DEVICE

Note: Co-implanted devices used for biventricular pacing include pacemakers (including leadless Micra pacemakers), defibrillators, or CRT systems. Review the co-implant device technical manual and IFUs for a complete description of warnings and cautions. Warnings and cautions related to the co-implanted device will continue to apply.

The WiSE CRT System replaces the pacing function of a coronary sinus (CS) lead when used in conjunction with a typical, commercially available implanted pacemaker, defibrillator, or biventricular pacing device to achieve CRT. The WiSE CRT System will trigger a LV pacing pulse immediately after sensing the RV pacing output from the pacing lead of the co-implanted device.

Review the IFU associated with the co-implanted device. Program the co-implanted device to deliver RV pacing in the appropriate mode and timing interval settings as required for CRT.

The WiSE CRT System functionality relies on detection of the RV pacing spike from the co-implant device. The WiSE CRT System measures the pulse width of RV pacing signals to synchronize to the RV pacing output. In single chamber pacing modes this is straightforward, however, to do this reliably in dual chamber pacing modes, the System must distinguish RV pacing from right atrial (RA) pacing. The WiSE CRT Transmitter must be initialized with the pacing pulse widths being used by the co-implanted device. The RV pacing pulse width of the co-implant pacemaker must be programmed at or above 0.35 ms up to a maximum of 2.0 ms. In dual chamber modes, the atrial and RV pulse widths must be programmed with at least 0.3 ms difference. In single chamber, RV pacing modes, where there is no atrial pacing, the RV pacing pulse width of the co-implant pacemaker must be programmed at or above 0.35 ms. Refer to **Table 1** for an example of co-implant settings.

Table 1. Co-Implant Setting Example

Mode	RV Pulse Width	RA Pulse Width
Dual Chamber (e.g., DDD)	0.4 ms	Min 0.1 ms or > 0.6 ms (= 0.3 ms difference)
Single Chamber (e.g., VVI)	0.4 ms	Not applicable

The WiSE CRT System may be implanted with any co-implanted pacemaker, defibrillator, or biventricular pacing device with the following capabilities and required settings:

- Right ventricular pacing lead or leadless Micra pacemakers implanted and functional
- Programmed pacing modality that utilizes RV pacing
- Pacing pulse width settings for the RV lead programmable at 0.35 ms or above
- Separately programmable atrial pacing pulse width settings in dual chamber modes that allow for differences of 0.3 ms or greater than those used for RV pacing
- Auto capture or lead impedance measurement algorithms that automatically adjust the pulse width of the co-implant device must be programmed to OFF
- Any other feature or operation, for example thoracic impedance sensing that initiates an electrical output must be programmed to OFF

The WiSE CRT System will synchronize to the co-implanted RV pacing signal (the pacing spike) and track rates up to 140 bpm (minimum 430 ms pacing interval). Pacing by the co-implanted device above 140 bpm will inhibit the WiSE CRT System from providing biventricular pacing until the pacing rate drops below 140 bpm. High-rate pacing by the co-implanted device, for example for pace termination of ventricular tachycardia, may result in WiSE CRT BiV pacing the left ventricle, but only to a maximum rate of 140 bpm.

Note: Regarding co-implanted CRT-defibrillator (CRT-D) or CRT-pacing (CRT-P) devices:

- Enabling coronary sinus pacing from a co-implanted CRT-P or CRT-D with the WiSE CRT System may inhibit WiSE CRT pacing. Disable coronary sinus pacing modes in a co-implanted CRT-P or CRT-D device.

4 IMPLANTING THE BATTERY AND TRANSMITTER

4.1 OPENING STERILE CONTAINERS

The WiSE CRT Battery and Transmitter modules are separately packaged in a double tray (a tray inside a tray) each with a sterile barrier sealed lid.

The following should be performed carefully to ensure safe handling onto the sterile field:

1. Check the device package for the use-by date. Do not use devices which are past the use-by date marked on the package.
2. Remove the device tray and the contents from the outer boxes. Retain the registration materials.

3. Check the label on the tray lid to ensure that the device name and model number match the required device.
4. Inspect the device package for damage. Do not use the device if the packaging has been damaged, the seals have been opened, or the packaging is wet. Return any package to EBR that does not appear to present a sterile barrier.
5. Locate the accessible corner of the outer tray lid, grip the peelable edge, and peel back the cover.
6. The tray and its contents are sterile and should be removed by a sterile gloved hand and placed on a sterile surface, or without touching, by emptying the contents of the package onto a sterile surface.
7. The inner tray and its contents are sterile and should be removed by a sterile gloved hand and placed on a sterile surface, or without touching, by emptying the contents of the package onto a sterile surface.
8. Discard the trays and covers.

4.2 Assessing Patient and Procedural Status

The subcutaneous implant of the Battery and Transmitter are usually performed before implanting the Electrode. This order of procedures allows the WiSE CRT System to best align the Electrode implant with the location of the Transmitter.

See the Electrode Catheter IFU for Electrode implant procedures.

4.3 Implant Procedure

To achieve consistent performance, the Transmitter must be stable relative to the acoustic window during patient movement and respiration. This requires the Transmitter to be positioned on the anterior surface of the intercostal muscle, beneath overlying muscle layers, with the target being the external intercostal muscle. Depending on the ICS used, these may include pectoralis, rectus abdominus, serratus, and/or external oblique muscle layers. The Transmitter is stabilized within the ICS by suturing the device's attachment wings to the costal cartilage.

Figure 14 reflects general positioning for the Transmitter and Battery. The Transmitter position will be dependent on the selected ICS. The cable must exit the Transmitter position laterally. The Battery position is typically along a superior/ inferior direction on the mid-axillary line.

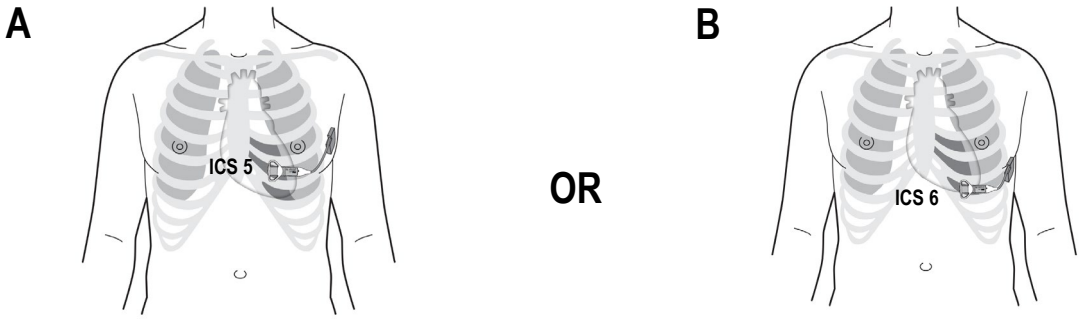


Figure 14. Typical Positioning for Transmitter and Battery

Surgical dissection down to the anterior surface of the intercostal muscle is required for the sub muscular implant and stabilization of the Transmitter. A channel along the anterior plane of the intercostal muscle is formed as a conduit from the Transmitter incision to the Battery pocket. The Transmitter is then inserted into the medial aspect of this channel. Careful dissection and blunt force tunneling are required to avoid risk of perforation of the ICS muscle and pleural cavity.

4.3.1 Confirming Acoustic Window and Transmitter Implantation Site

1. Abduct the patients left arm back to expose the battery implant site.

   Note: Care should be taken to move and tape breast tissue away from the acoustic window target, to avoid performing the initial incision on this tissue and movement of acoustic window markings.

2. Perform a shortened version of the screening process at the start of the implant procedure before sterile preparation of the patient. This is required even if the marks from the pre-implant screening are present because retracting the left arm will cause the skin to shift making the previous marks incorrect. At a minimum, the shortened screening should include:

   a. Marking of the centerline of the sternum

   b. Marking of the mid 4th, 5th, and 6th ICS measurement from the Acoustic Window Screening form

   c. Palpate 4th to 6th rib anatomy

   d. Identification of the sternal angle and 2nd rib with linear (vascular) probe

   e. Counting of the ribs to the target ICS identified from the acoustic window screening

   f. Marking of the superior and inferior ribs for the identified target acoustic window

   g. Location and verification of the 1 cm acoustic window location on the chest

   h. Marking the location of the 1 cm width of the identified acoustic window, extending the line between the ribs 4 cm vertically

   i. Following the ICS laterally for 6 cm to confirm 1 cm width spacing along the ICS

   j. Confirmation of the absence of lung encroachment in the targeted ICS acoustic window using the cardiac probe

   k. Confirmation of angulation and distance from the ICS to target Electrode implant locations

Note: The previously completed Acoustic Window Screening Form and associated measurements must be used as a guide.

4.3.2 Preparing the Transmitter and Battery Implant Locations and Cable Tunnel

1. Make a 4 cm minimum vertical skin incision along the medial edge of the acoustic window in the ICS selected for the Transmitter implant.

   Note: A minimum 5 cm non-vertical/ horizontal incision parallel to the superior and inferior rib can be considered when breast tissue is directly over the target ICS.

2. Incise through the subcutaneous fat until the first muscle layer is exposed.

3. Palpate the overlying muscle layer to locate the costal cartilage of the superior rib. As a safety consideration, incise through the muscle layers over the superior rib.
4. Palpate the overlying muscle layer to locate the costal cartilage of the inferior rib. As a safety consideration, incise through the muscle layers over the inferior rib.
5. Using the small retractor, retract the muscle layers to visually identify the anterior surface of the costal cartilage of the superior rib (**Figure 15**).

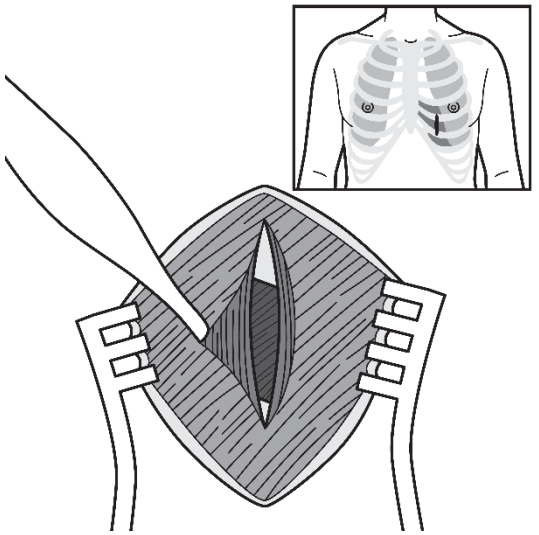


Figure 15. 4 cm Minimum Vertical Skin Incision along Medial Edge of Acoustic Window with Muscle Layers Retracted to Expose Anterior Surface of Costal Cartilage of Superior Rib

6. Working from the inferior edge of the exposed cartilage of the superior rib, use the small retractor to retract back the overlying muscle to expose the anterior plane of the intercostal muscle. The intercostal muscle is identifiable as a fibrous sheet of muscle running diagonally between the costal cartilage.
7. Dissect through the overlying muscle inferiorly exposing the full span of the intercostal muscle between the costal cartilages of the superior and inferior ribs.

   Note: Do not form a pocket for the Transmitter using tools, fingers, or other means as this will lead to an oversized area for the Transmitter, reducing its stability, and potentially impacting performance of the implanted System.
8. Clean and move any excess tissue from the exposed costal cartilage of the superior and inferior rib with the small retractor. These will be the suture sites for the Transmitter wings.

   Note: Do not over clean at the suture sites and do not use electrocautery. This will avoid unintended damage or removal of the periosteum.
9. Use the cardiac probe in sterile sleeve and carefully place inside dissected pocket to confirm lung free view of the left ventricle:
   - Confirm probe/ sleeve are prepared with ultrasound gel inserted inside the sterile sleeve.

- Confirm probe is placed in the ICS with the probe marker pointing to 9 o'clock and that it is not over a rib.
- Re-confirm with live echocardiographic measurements that the dissected ICS correlates with the acoustic window mark-up of the target region.

10. Form a Battery pocket along a superior/ inferior direction on the mid-axillary line of the patient's left lateral chest wall. The Battery pocket should be made using Langer's Lines, in-line with the Transmitter pocket. The pocket's incision length should be equal to the Battery dimension that is to be inserted into the pocket. The pocket for the Battery is then formed inferior to the incision. The pocket is typically formed beneath subcutaneous fat and superficial to the abdominal muscles in a manner and sizing similar to that of conventional pulse generator pockets.

Note: To improve the comfort of female patients, consider making the Battery pocket incision at the mid-axilla, but cranial to the location of a bra sideband. A post-surgical recovery bra with a wider sideband and without underwire should also be considered for extra comfort to potentially reduce sideband interaction with the incision.

11. Remove the spreader, as it can interfere with the tunneling process.

12. Insert the tunneling tool into the Transmitter pocket, horizontal to the patient's chest on the anterior surface of the intercostal muscle and the posterior fascia of overlying muscle. Advance the tunneling tool laterally along the defined plane.

Note: Ensure the tunneling tool is inserted onto the correct layer prior to proceeding. Tunneling on the incorrect tissue plane can result in Transmitter instability and cable damage.

13. Advance laterally until the distal end of the tunneling tool enters the Battery pocket (**Figure 16**).

Note: Do not angle the tip of the tunneling tool down toward the thoracic cavity. If resistance is felt, stop; then retract the Tunneling Tool completely. Re-assess the insertion site to ensure the tunneling tool is positioned over the anterior surface of the intercostal muscle before continuing.

Note: For proper stabilization, the tunnel must traverse the anterior surface of the intercostal muscle for at least 10 cm. This is required to ensure that the rigid section of the Transmitter does not extend into mobile anterior muscle layers (**Figure 16**).

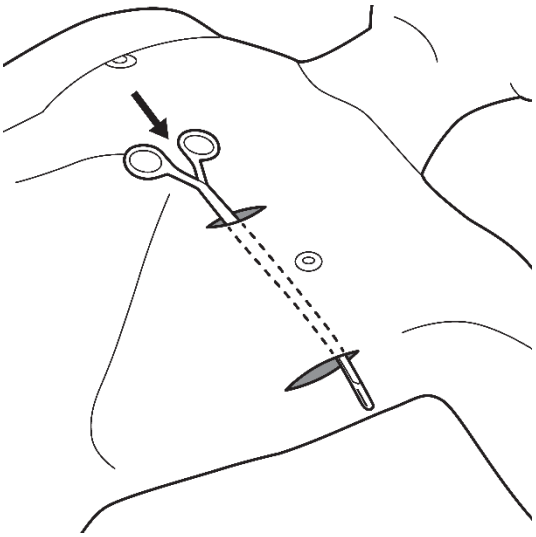


Figure 16. Directing Tunneling Tool along Intercostal Muscle and through Anterior Tissue Layers to Battery Pocket

14. The routing tube is used as a conduit for routing of the cable. Loop the tube through the distal tip of the Tunneling Tool. Pull the tunneling tool back through the tunnel, leaving the tube in place traversing between the Battery pocket and Transmitter incision (**Figure 17**).

Note: Use this routing tube technique to avoid damaging the cable connector. DO NOT route the cable by pulling the cable through the channel with surgical instruments. NEVER grasp the cable or cable connector with surgical instruments as this can cause damage to the cable.

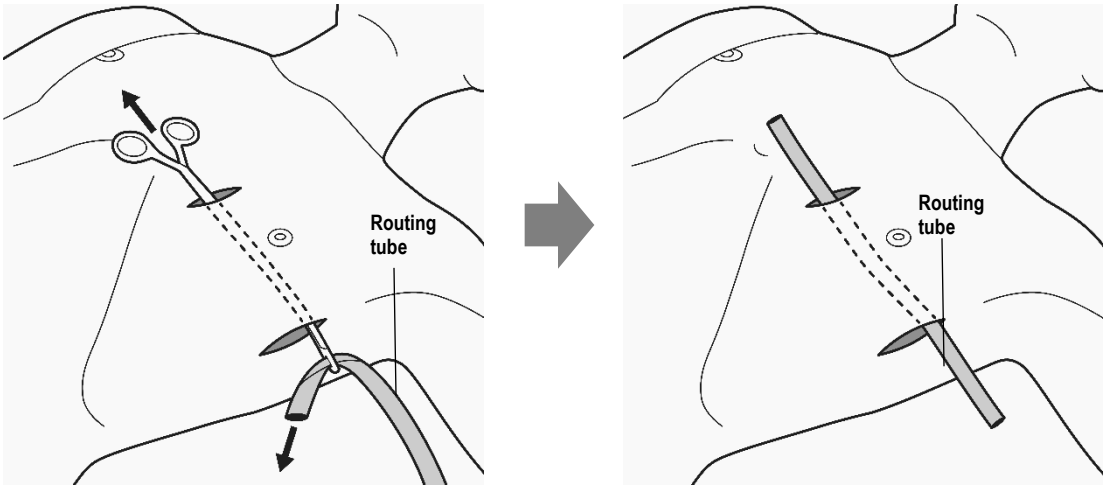


Figure 17. Placing Routing Tube for Use in Transmitter Implant

4.3.3 Positioning and Securing the Transmitter:

1. Insert the Transmitter's cable into the routing tube and with tension on both ends pull through to the Battery pocket (**Figure 18**).

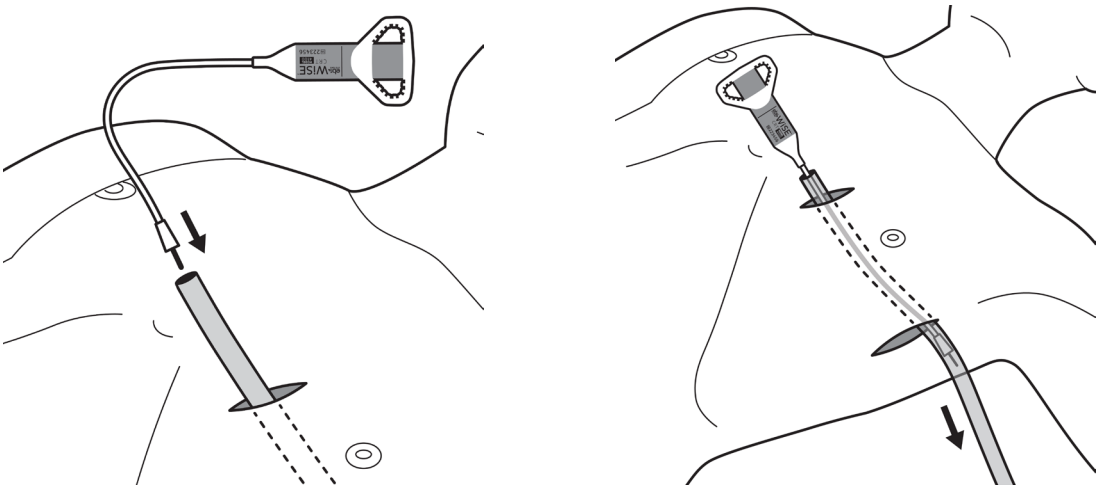


Figure 18. Using Routing Tube to Direct Transmitter Cable into Place

2. Remove the routing tube from the Transmitter tunnel, leaving the Transmitter and cable in place.
3. Using the small retractor, expose/ clean a sufficient area of the costal cartilage to accommodate the attachment of the Transmitter's wings.

   Note: To prevent shifting of the Transmitter with patient movement, the attachment wings of the Transmitter must be placed on the anterior surface of the ribs with no muscle between the wings and the costal cartilage.
4. Perform a test fit of the Transmitter in the pocket. Ensure it fits into the desired location and that there is no remaining tissue in the location where the wings will be sutured.
5. The Transmitter must be permanently secured within a tight space to minimize movement of the device. Optionally, if space for the Transmitter body is too tight, use the Dilator to increase the space by advancing the Dilator approx. 7 cm into the tunnel.
6. Position the Transmitter as medial in the ICS as possible while maintaining a stable position of the attachment wings on top of the ribs. The Transmitter label must be facing up and the attachment wings on the top of the Transmitter should span the two adjacent cartilages (**Figure 19**).

   Note: The final position of the Transmitter must correspond to the location determined by the acoustic window screening.

R

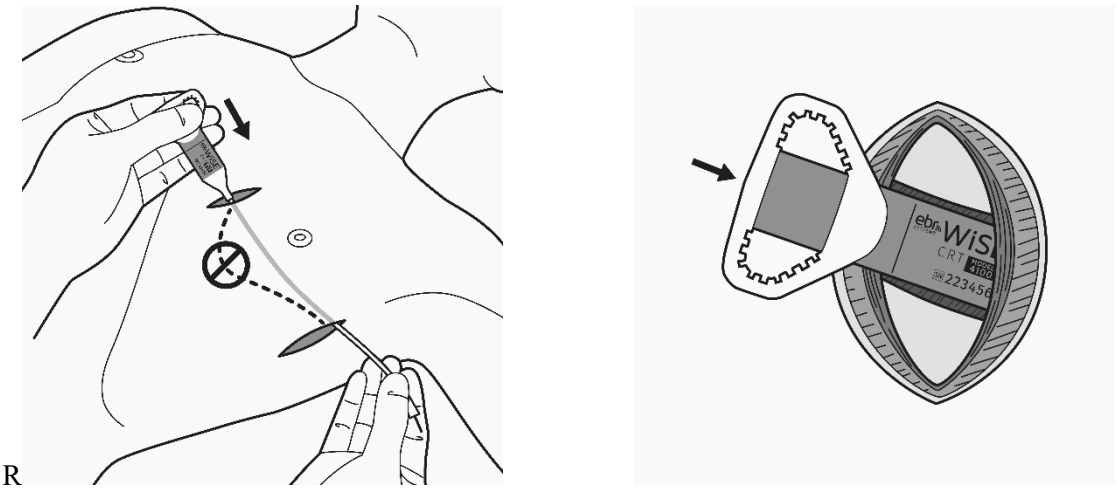


Figure 19. Positioning Transmitter into the Tunnel

7. Retract any muscle tissue from under the attachment wings preventing the wings from sitting directly on top of the costal cartilages (**Figure 20**).

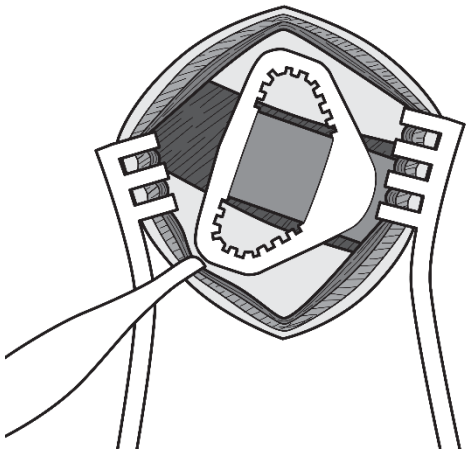


Figure 20. Ensuring Transmitter's Attachment Wings Sit Directly on Top of Costal Cartilages

8. The Transmitter is secured within the ICS with a minimum of two, non-absorbable sutures (one on each wing) placed through the outer layer (perichondrium) of the costal cartilage using a tapercut needle and tied over the attachment of the wings. There are two techniques that can be used to secure the Transmitter:

- Option 1: Remove the Transmitter from pocket and pre-lay a minimum of one non-absorbable suture to the superior and one to the inferior costal cartilages.
- Option 2: With the Transmitter in the pocket in the required medial location, secure the Transmitter with a minimum of one non-absorbable suture to the superior and one on the inferior costal cartilages.

9. To accommodate variations in the curvature and profile of the costal cartilages, the sutures can be installed anywhere around the perimeter of the attachment wings to prevent Transmitter movement. Tighten all sutures such that they engage the catch features on the internal surface of the attachment wings (**Figure 21**).
10. Downward pressure should be applied to both the Transmitter and wings while the sutures are being tied down.
11. The securement of the Transmitter is confirmed via the "tug-test". The small retractor is placed under the distal end of the Transmitter and is slowly lifted to assess for movement. If there is any movement, additional sutures should be applied to the wings of the Transmitter and the "tug-test" repeated.

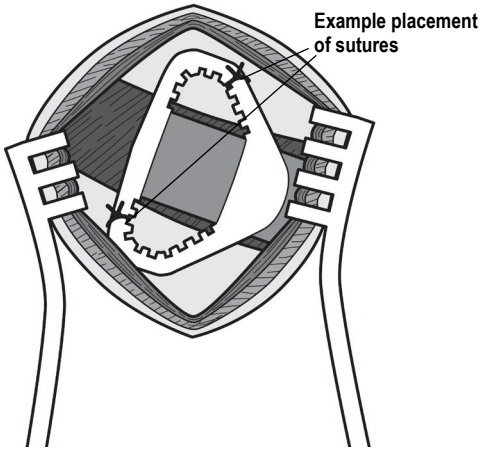


Figure 21. Securing Transmitter with Sutures Tied over the Attachment Wings

4.3.4 Connecting the Transmitter Cable to the Battery:

Note: Only insert the Transmitter cable into the Battery header:

- Do not insert a pacing or defibrillation lead into the connector block of the Battery.
- Do not insert any conductive object, for example hemostat, scalpel, etc., into the connector block of the Battery.
- Do not insert the cable connector from the Transmitter into a pacemaker or defibrillator lead port.
- Do not apply any fluid to the Transmitter cable or Battery header

The following steps should be followed when connecting the Transmitter cable to the Battery:

1. The Battery tray contains the Battery with a protective plug in the header and contains a torque wrench (**Figure 22**). To remove the protective plug from the Battery, insert the torque wrench into the screw port and loosen (counterclockwise) the set screw by carefully unscrewing. Pull the protective plug from the header and discard.

   Note: Any time it is necessary to loosen the setscrew, take care not to disengage the screw from the port. The protective plug does not prevent fluid intrusion into the connector cavity. The

Battery should only be exposed to fluids after the cable connector is inserted and the set screw is tightened.

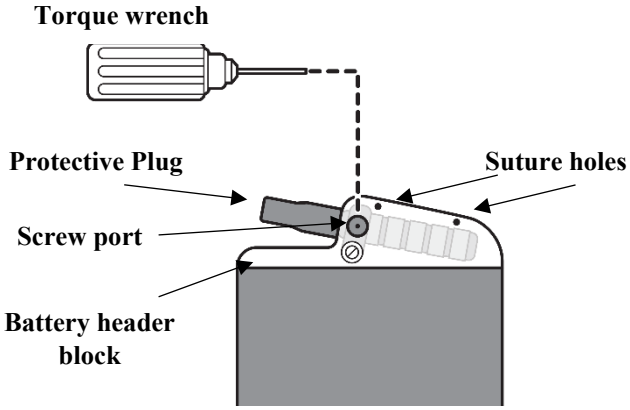


Figure 22. Removing Protective Plug from Battery

Inspect the end of the cable connector and wipe the cable connector with a clean and dry swab.

Warning: Do not apply any fluid to the cable or connector.

2. Inspect the Battery header. Ensure that there is no fluid or other material inside the connector block. If fluid or other material is present, a new Battery must be used.
3. Insert the cable connector fully into the header block of the Battery.
4. Visually inspect the header block and verify that there is only a small gap (approximately 1 mm), as shown in **Figure 23**, between the cable strain relief and the Battery header block. If the gap appears larger, loosen the setscrew in ½ turn increments while attempting to insert the connector fully into the Battery header.

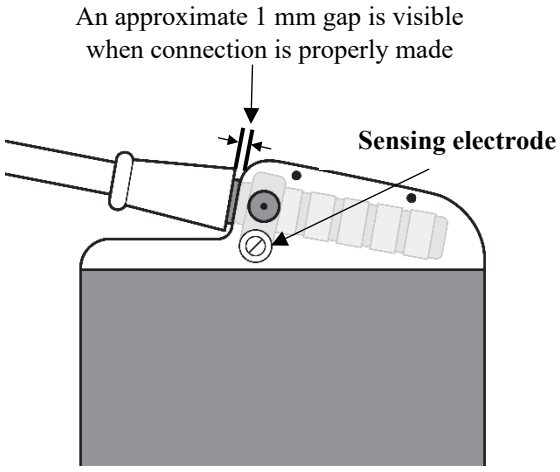


Figure 23. Inspecting Cable Connection to Battery

5. Insert the torque wrench into the screw port and tighten the screw.
6. Check that the connector is secured in place by the setscrew by carefully trying to disconnect the cable.

   Note: The screw must be tightened with the torque wrench until the wrench emits an audible click.

During a Battery replacement procedure, it is recommended to wait around 10-15 seconds before reconnecting the Transmitter to the new Battery. This is done to ensure the Transmitter initializes properly.

4.3.5 Confirming Functional WiSE CRT System with the Programmer

1. On the WiSE CRT Programmer, select the CONNECT screen from the main menu, then press SEARCH. The Programmer should find the Transmitter and display it by serial number. Select the device then press CONNECT. Confirm that the Programmer connects to the Transmitter and the device REPORT screen.

   See the WiSE CRT System Programmer IFU for set-up and operating instructions.

   Note: Take care to ensure that the proper Battery model is recorded by the Programmer. Incorrect programming can lead to misleading end of Battery life estimations.

   Prior to implanting a Battery, check the “Battery” section of the Programmer (M5100) Report Screen. The “Status” should be “OK” and “Remaining Capacity” should be 100%. If these values are not shown, return the Battery to EBR for analysis and use another Battery.

   If you are replacing a Battery and inadvertently answered “No” in the “New Battery?” dialog box this can cause the displayed Battery capacity to be less than 100%. If this occurs, disconnect the Transmitter from the Battery and then reconnect and repeat **Section 4.3.5**. This will cause the “New Battery?” dialog box to re-appear allowing you to answer “Yes”.

4.3.6 Positioning and Securing the Battery in the Pocket

The Battery must be permanently secured within the pocket to minimize movement of the device. The Battery header block contains two suture holes for this purpose (**Figure 22**). Sutures are used to secure the Battery. The suture holes have been sized for a 2.0 suture.

1. Using a non-absorbable suture, install and tie off two sutures in the Battery suture holes.
2. Secure the sutures to the tissue fascia within the Battery pocket.
3. Ensure any excess cable from the Transmitter is pulled into the Battery pocket. Then, loosely coil any excess cable from the Transmitter into one loop under the Battery.

   Note: Ensure excess cable has been pulled through to the Battery pocket and the cable is not twisted or kinked. Insert the Battery and cable into the pocket such that the connector block is at the top of the pocket. The long axis of the Battery should be oriented vertically with the header towards the patient’s head and the logo side facing anterior (out).

   Note: If a test fit is to be performed, insert Battery as described in Step 4. Visualize the location of the suture holes in the Battery header and identify proximal tissue for installation

of sutures. Then remove the Battery and cable from the pocket while maintaining the same rotation of the Battery and cable coiling if possible.

Note: Do not disconnect the cable connector after the Battery is positioned in the pocket and removed. Disconnection will cause body fluids to be sucked into the Battery connector cavity.

4. Tighten and tie off both sutures checking to make sure that they are not pinching any portion of the cable.

If an antibacterial absorbable envelope is to be used, covering the sensing electrode on the Battery must be avoided.

4.3.7 Completing Implantation of the Transmitter and Battery

1. Suture closed the Battery pocket and then the Transmitter incision.
2. For the Transmitter incision, suture the overlying muscle layers over the Transmitter such that the Transmitter is secured beneath the overlying muscles. It is important to remove any air from both the Transmitter and Battery implantation sites. While suturing closed the Battery pocket, press on the pocket to force air up and out the Transmitter pocket. Remove any air from the Transmitter incision while suturing it closed.
3. Suture closed the skin layers of the Transmitter incision and Battery pocket.
4. Complete and review the registration materials provided in the packaging and return the completed registration forms to EBR.

4.4 Battery and Transmitter Replacements

The following steps describe the process for Battery and Transmitter replacements:

1. Make an incision over the existing Battery incision scar.
2. Cut and open carefully, to avoid damaging the header and/or cable.
3. Locate and cut the Battery fixation sutures. Remove the rest of the suture from the fascia to reduce risk of infection.
4. Remove the old Battery from its pocket.
5. Cut the cable close to the connector.
6. Tie a routing tube onto the Transmitter cable.
7. Make an incision over the existing Transmitter scar.
8. Cut down through overlying muscle layers until the anterior surface of the Transmitter becomes visible.
9. Locate and cut the superior and inferior sutures on the Transmitter wings and remove the rest of the sutures.
10. Using the small retractor, lift the Transmitter and remove it fully from the pocket.
11. The routing tube is now in place between the Transmitter and Battery pockets.
12. Insert the NEW Transmitter cable as far as it can go into the routing tube and with tension on both ends of the tube, pull through to the Battery pocket.

Note: If resistance is felt when pulling the NEW Transmitter cable through, remove the Transmitter and insert the tunneling tool through the routing tube. Remove the tunneling tool and repeat the steps to route the Transmitter cable.

13. Continue with standard implant steps as described in **Section 4.3.3.**

4.5 Battery Replacement

The following steps describe the process for Battery replacements:

1. Make an incision over the existing Battery incision scar.
2. Cut and open carefully to avoid damaging the header and/or cable.
3. Locate and cut the Battery fixation sutures. Remove the rest of the suture from the fascia to reduce risk of infection.
4. Remove old Battery from pocket.
5. Insert the torque wrench into the screw port and loosen the screw.
6. Hold the connector stable and disconnect from the Battery.
7. Continue with standard implant steps as described in **Sections 4.3.4** and **4.3.5**

4.6 Explant, Cleaning, and Disposal of Devices

The following steps describe the process for explanting, cleaning, and disposal of devices:

1. Program the WiSE CRT System operational mode to OFF prior to explant.
2. The Battery module contains an energy cell that may explode if incinerated. Explant the Battery and the Transmitter prior to cremation or burial. Implanted WiSE CRT System devices are SINGLE USE only.
3. Explanted Battery and Transmitter devices should be wiped clean using typical hospital cleaning and disinfecting solutions and then sterilized by ethylene oxide processes used by the hospital.
4. Return all explanted devices to EBR to assist with full life-cycle device traceability and to ensure safe and environmentally sensitive disposal.

5 Technical Specifications

5.1 Transmitter Ultrasound Specifications

TRANSMISSION VALUES	
Ultrasound Frequency	921.25 kHz
Targeting Zone	90° (± 45); range 3-16 cm
Targeting Transmissions per Cardiac Cycle	Rate: 1-2 kHz (typical) Bursts per cardiac cycle: 5 (typical) -128 (max) Pulse width range: 16 µs
Pacing Transmission	Rate: 2.33 Hz (max) Bursts per cardiac cycle: 1

TRANSMISSION VALUES
Pulse width range: 0.01 ms – 4.4 ms

EXPOSURE LEVEL	Mechanical Index	Ispta (mW/cm^2)	Isppa (W/cm^2)
Global Maximum Value	0.43	49.6	4.44
Nominal	0.17	0.34	0.65

5.2 TRANSMITTER PHYSICAL AND MATERIAL SPECIFICATIONS

TRANSMITTER MODEL M4100 AND CABLE	
Volume	8 ml
Width x Height x Thickness (Enclosure)	17.5 x 83.3 x 6.8 mm
Minimum Cable Working Length x Diameter	233 mm x 4 mm (12 F)
Mass	22 g
Sensing Electrode Area-Material	2.2 mm^2 – Platinum/Iridium
Number of Sense Electrodes	4
Adjacent Sense Electrode Spacing	Vertical pair spacing:15 mm Horizontal pair spacing: 64 mm Front-Back pair spacing: 7 mm
Patient Contact Materials	Titanium, Alumina, Platinum/Iridium, Epoxy (Bisphenol A Diglycidyl Ether Resin), Silicone, Parylene, Ultra High Molecular Weight Polyethylene, Tecothane

5.3 TRANSMITTER PARAMETERS

PERMANENT PARAMETERS	Values/ Range
Mode	RV Synchronous, Sense Only, OFF
Transmit Level*	1, 1.5, 2, 2.5, 3, 4, 5, 6
Transmit Pulse Width (ms)	0.01, 0.02, 0.05, 0.07, 0.1, 0.15, 0.2 to 2.0 in increments of 0.1, 2.5, 3.0, 3.5, 4.4

TEMPORARY LVOO PARAMETERS	Values/Range
Pacing Rate (bpm)	30 – 150 in increments of 5
Transmit Level*	1, 1.5, 2, 2.5, 3, 4, 5, 6
Pulse Width (ms)	0.01, 0.02, 0.05, 0.07, 0.1, 0.15, 0.2 to 2.0 in increments of 0.1, 2.5, 3.0, 3.5, 4.4

*The Transmit Level adjusts the drive voltage which excites the ultrasound transmission over a range from 5.24 V (TL = 1) to 12.65 V (TL = 6). It is not the pacing voltage delivered to the tissue. See M1000 (Model 1000) Electrode IFU for pacing impedance and voltage output limit.

CO-IMPLANT DETECTION PARAMETER	Values/ Range
RV Pulse Width (ms)	0.35 – 2.00 in increments of 0.05

TARGETING PARAMETERS	Values/ Range
Focal Distance	Off, Close (< 4 cm), Near (4-5 cm), Typical (5-8 cm), Far (> 8 cm)
Distance Limit Close	AUTO, NONE, 0.0 cm to 16.9 cm
Distance Limit Far	0.0 cm to 16.9 cm
Threshold Tuning	2.0, 2.5, 3.0, 3.5, 4.0
Location Sensing	Pulse Generator Vertical, Pulse Generator Horizontal, Pulse Generator Front/Back, Pulse Generator/Battery, Horizontal + Vertical, Horizontal + Battery, Vertical + Battery, Horizontal + Front/Back, Vertical + Front/Back, Front/Back + Battery

OPERATIONAL TIMING	
Max VOO Pacing Rate (interval)	150 bpm (400 ms)
Max RV Sync Rate (interval)	140 bpm (429 ms)
Max RV Detection Rate (interval)	286 bpm (219 ms)
Min RV Detection Rate (interval)	27 bpm (2.25 sec)
Post Pacing RV Detection Blanking	200 ms
RV Detection Pulse Width Accuracy	< 30.5 µs
LV Pacing Pulse Width Accuracy	< 1.1 µs
LVOO Pacing Interval Accuracy	< 12.5 ms
Nominal RV Detection to LV Pace Delay	3 ms
Max RV Detection to LV Pace Delay	12.55 ms

CO-IMPLANT PULSE CHARACTERISTICS	Requirement
Pulse Width Accuracy	< ± 40 µs or ± 5%
Pulse Width Leading Edge Rise	< 10 µs
Charge Balance Edge Delay from Trailing Edge	< 200 µs
No Pulse Output after RV Pace (ms)	> 100

5.4 TRANSMITTER SHIPPED AND RESET VALUES

PERMANENT PARAMETERS		
	Shipped	**Reset**
Mode	OFF	Saved Memory
Transmit Level	1	Saved Memory
Pulse Width (ms)	0.4	Saved Memory
RV Pacing Spike Detection	Not initialized	Saved Memory

DATA	**Shipped**	**Reset**
Patient Information	Cleared	Saved Memory
System Counters	Cleared	Most Recent Daily Snapshot

TEMPORARY LVOO PARAMETERS	**Shipped**	**Reset**
Pacing Rate (bpm)	70	Saved Memory
Transmit Level	1	Saved Memory
Pulse Width (ms)	0.4	Saved Memory

TARGETING PARAMETERS	**Shipped**	**Reset**
Focal Distance	Typical (5-8 cm)	Saved Memory
Distance Limit Close	Auto	Saved Memory
Distance Limit Far	16.9 cm	Saved Memory
Threshold Tuning	3.0	Saved Memory
Location Sensing	Pulse Generator Vertical, Pulse Generator Horizontal, Pulse Generator Front/Back, Pulse Generator/Battery	Saved Memory

5.5 TRANSMITTER RADIO SPECIFICATION

RADIO OUTPUT POWER			
	Low Frequency	**High Frequency**	**Rated RF Power Output**
Medical Implant Comm. Service (MICS)	402 Mhz	405 Mhz	1.585 µW
Receiver Specification	2443 Mhz	2457 Mhz	Receive Only

5.6 FEDERAL COMMUNICATIONS COMMISSION (FCC)

The FCC ID for this device is 2AMRX-4100.

This device may not interfere with stations operating in the 400.150-406.000 MHz band in the meteorological aids, meteorological-satellite, and earth exploration-satellite services, and must accept any interference received, including interference that may cause undesired operation.

5.7 Battery Physical, Electrical, and Material Specifications

BATTERY M3100	
Volume (Enclosure and Header)	54 ml
Width x Height x Thickness	48.7 x 111.1 x 11.4 mm
Mass	93 g
Sensing Electrode Area-Material	5.1 mm^2 – Platinum/Iridium
Number of Sense Electrodes	1
Chemistry	Li/AgV2O5.5/CFx
Nominal Capacity	15 Ah (150 KJ)
Patient Contact Materials	Titanium, Platinum/Iridium, Silicone, Parylene, 300 Series Stainless Steel, Epoxy (Bisphenol A Diglycidyl Ether Resin)

5.8 Battery X-ray Identification

The WiSE CRT Battery M3100 contains a radiopaque identifier that is visible under X-ray. The identifier may be read, when necessary, without knowledge of the make or model of device and without the need for a surgical operation. The radiopaque identifier shown below contains an icon that is unique to EBR and a two-character code by which EBR can associate the model of the device.

WISE CRT BATTERY RADIOPAQUE IDENTIFIERS	
Battery M3100	

6 WiSE CRT System Acoustic Window Screening Form

Patient:	**Site Name:**		**Date:**
ADIPOSE THICKNESS MEASUREMENT – Linear Probe (Distance from top of image sector to top of ribs)			
	4th ICS cm	5th ICS cm	6th ICS cm
ICS REFERENCE MEASUREMENTS – Linear Probe (Distance from suprasternal notch to mid-ICS)			
	4th ICS cm	5th ICS cm	6th ICS cm
ACOUSTIC WINDOW LOCATION – Linear Probe (Distance from midsternal line to 1cm ICS width spacing) *> 1cm width spacing for approximately 6 cm laterally within ICS –* ***If not, do NOT further assess ICS***			
	4th ICS cm	5th ICS cm	6th ICS cm
TARGET IMPLANT SITE INFORMATION – ACOUSTIC WINDOW LENGTH - Cardiac Probe (Distance from 1cm ICS width location to loss of image due to Lung Encroachment (LE) or up to 5 cm) ***In case of LE in any posture (< 2.5cm AW length) do NOT further assess ICS***			
Supine	4th ICS cm	5th ICS cm	6th ICS cm
Right Side	4th ICS cm	5th ICS cm	6th ICS cm
Sitting /Standing	4th ICS cm	5th ICS cm	6th ICS cm
AW ≥ 2.5 cm	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
TARGET IMPLANT SITE INFORMATION – SEPTAL LV TARGET LOCATION - Cardiac Probe			
Location	Basal ☐ Mid ☐	Basal ☐ Mid ☐	Basal ☐ Mid ☐
Cranial-Caudal (CC) Angle	4th ICS °	5th ICS °	6th ICS °
Distance	4th ICS cm	5th ICS cm	6th ICS cm
Medial-Lateral (ML) Angle	4th ICS °	5th ICS °	6th ICS °
Total Angle *(CC+ML Angle)*	4th ICS °	5th ICS °	6th ICS °
LV Wall Thickness ≥ 5mm	Yes ☐ No ☐ ____mm ***If No, do NOT further assess site***		
TARGET IMPLANT SITE INFORMATION – LATERAL LV TARGET LOCATION - Cardiac Probe			
Location	Basal ☐ Mid ☐	Basal ☐ Mid ☐	Basal ☐ Mid ☐
Cranial-Caudal Angle	4th ICS °	5th ICS °	6th ICS °
Distance	4th ICS cm	5th ICS cm	6th ICS cm
Medial-Lateral Angle	4th ICS °	5th ICS °	6th ICS °
Total Angle *(CC+ML Angle)*	4th ICS °	5th ICS °	6th ICS °
LV Wall Thickness ≥ 5mm	Yes ☐ No ☐ ____mm ***If No, do NOT further assess site***		
TARGET IMPLANT SITE - SUMMARY ***If multiple ICS show adequate Distance and Angle, largest AW Length should be selected as Target Site.*** ***Include any known cardiac abnormalities that could impact the system's implantation or functionality.***			

7 MRI SAFETY INFORMATION

Refer to the Common Section IFU (LBL-05300) for MRI Safety Information for the implanted Battery (M3100) and Transmitter (M4100) of the WiSE CRT System.

8 SYMBOL GLOSSARY

Refer to the Common Section IFU (LBL-05300) for an explanation of the symbols found on the product or the product label for the implanted Battery (M3100) and Transmitter (M4100) of the WiSE CRT System.

WiSE® Cardiac Resynchronization Therapy (CRT) System

INSTRUCTIONS FOR USE

Electrode Catheter and Delivery Sheath

For use with:

- **WiSE CRT Electrode Catheter (M1000)**
- **WiSE CRT Delivery Sheath (M2000)**

EBR Systems, Inc.
480 Oakmead Parkway
Sunnyvale, CA 94085 USA
www.ebrsystemsinc.com
+1 (408) 720-1906
support@ebrsystemsinc.com

LBL-05301 Rev. 02 DRAFT

Table of Contents

1 DELIVERY SYSTEM COMPONENTS, REQUIRED SUPPLIES AND EQUIPMENT

The delivery system is the combination use of Electrode Catheter and Delivery Sheath comprised of two trays that contain the following main components (see Figures 1 and 2):

Tray 1 (Figure 1) WiSE CRT Electrode Catheter M1000 (Model 1000):

a) **One Electrode Catheter:** A 124 cm long, 2.8 mm/ 8- F outer diameter catheter, with an Electrode preloaded onto the distal end. It is inserted into the Delivery Sheath to advance the Electrode to the left ventricular wall and to anchor the Electrode into the tissue.

b) **Insertion Tool:** A shroud that is part of the Electrode Catheter used to insert the Electrode into the Delivery Sheath. It is packaged with an Electrode protection cap.

c) **One BLACK Reference Needle Electrode:** A stainless-steel needle assembled with a cable used as a far field reference and connected to equipment for electrogram monitoring and pacing.

d) **One RED Extension Cable:** A cable connected between the Electrode Catheter and equipment for electrogram monitoring and pacing.

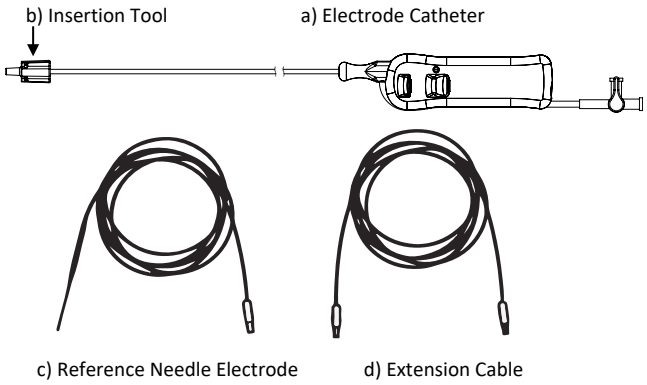


Figure 1. Tray 1 WiSE CRT Electrode Catheter M1000 with Contents

Tray 2 (Figure 2) WiSE CRT Delivery Sheath M2000 (Model 2000):

e) **One Delivery Sheath:** A 109.5 cm useable length, 4.0 mm / 12- F outer diameter, deflectable guide sheath used to position the Electrode onto the endocardial wall of the left ventricle.

f) **One Pigtail Catheter:** A 129 cm long, 2.7 mm / 8- F outer diameter tool with an 8 F pigtail distal section used over a guidewire to track the Delivery Sheath while accessing the left ventricle.

g) **Insertion Tool:** A shroud that is part of the pigtail catheter used to aid with the insertion of the pigtail catheter into the Delivery Sheath.

h) **One Flush Extension Line:** An extension with hub to connect to and to flush the pigtail catheter**.**

i) **One Syringe:** 3-ml syringe used to inflate the Delivery Sheath's balloon with diluted contrast.

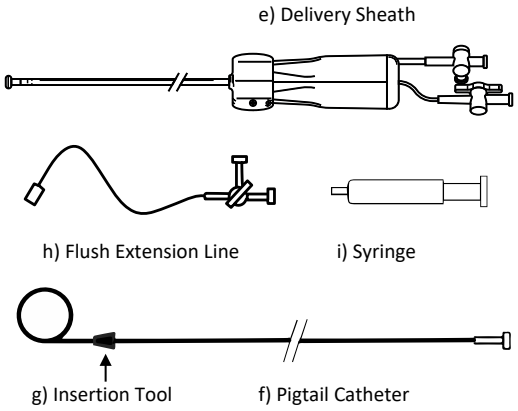


Figure 2. Tray 2 WiSE CRT Delivery Sheath M2000 with Contents

Additional supplies that are not included with the delivery system and should be available in the operating room during the Electrode implant procedure include:

- One 12 F inner diameter (ID) introducer for retrograde femoral arterial approach or one 12 F ID suitable introducer sheath for venous transseptal approach
- Angiographic contrast media
- Intravenous (IV) heparin
- Three IV pressure bags
- Three IV set-ups with heparinized saline
- Arterial manifold with extension line
- Contrast media injection syringe
- Two 20 ml luer lock syringes
- Two bowls for heparinized saline (flush in and flush out)
- One 180 cm soft, j-tipped guidewire (0.81 mm) 0.032" or (0.89 mm) 0.035"
- Arterial closure device(s) for 12 F sheath/ puncture for use with retrograde femoral arterial access

- Single-loop and a triple-loop snaring device with a minimum 150 cm length and 5 mm or 7 mm loop diameter

The equipment set-up in the implanting lab should be able to support the key safety mitigations (see **Section 4.1**) to ensure safe and effective Delivery Sheath manipulation within the left ventricle and implantation of the Electrode. Equipment should include:

- Real time echocardiography imaging, such as intracardiac echocardiography (ICE) or transesophageal echocardiography (TEE)
- Cineangiography (Cine) with a minimum acquisition setting of 15 frames/sec
- Electrogram monitoring using an electrophysiology (EP) recording system or a pacing system analyzer (PSA)
- Pacing stimulator for measuring pacing thresholds. This could be integrated into an EP recording system or through a PSA
- Co-implant programmer to re-program co-implant
- Pacing system analyzer measuring cable or cable-adapters to connect to an EP recording system
- Activated clotting time (ACT) measuring instrument
- External defibrillator
- Radiolucent 12-lead ECG

2 PRECAUTIONS

For use only by Qualified Medical Personnel in professional healthcare environments: The WiSE Cardiac Resynchronization Therapy (CRT) System is only for use by qualified cardiologist physicians and surgeons in professional healthcare facilities. EBR provides training for implant operators prior to using the system. The information provided in these Instructions for Use (IFU) is a required supplement to the Common Section WiSE CRT System IFU.

2.1 STERILE SINGLE USE DEVICES

- The WiSE CRT delivery system is sterilized by ethylene oxide gas processes after being packaged. Return any package to EBR that does not appear to present a sterile barrier.
- The WiSE CRT delivery system is for SINGLE USE only. Do not attempt to sterilize and reuse any implantable WiSE CRT device if it has previously been implanted in another patient.

2.2 STORAGE AND HANDLING

- Devices should be stored in their original packages in a dry, room temperature environment.

2.3 PRE-IMPLANT DEVICE CHECKING

- Check the device package for the expiry date/''use-by'' date. Do not use devices that are past the expiry date/''use-by'' date marked on the package.

- Inspect the device package for damage. Do not use the device if the packaging has been damaged, the seals have been opened, or the packaging is wet. Return any package to EBR that does not appear to present a sterile barrier.
- Check the package contents against the content list in Section 1. Do not use the device if any of the listed components are missing from the package.

2.4 IMPLANTATION

- Use only recommended compatible (**Section 1**) sheath, introducer, guidewire, and other items listed under the additional supplies section.
- Follow the device manufacturer's Instruction for Use when using supplies not provided with the WiSE CRT Electrode delivery system.

3 ANTICOAGULATION ADMINISTRATION

Caution: Arterial catheterization procedures require administration of appropriate anticoagulation to protect against thrombus formation on the delivery system during the procedure.

At the time of insertion of the Delivery Sheath into the introducer, ensure that the patient's ACT is a minimum of 200 seconds and maintain at or above this minimum until the Electrode delivery system is withdrawn.

4 IMPLANTING THE ELECTRODE IN THE LEFT VENTRICLE

Implanting the WiSE CRT Transmitter and Battery prior to implanting the Electrode allows determination of the Electrode implant location relative to the Transmitter location.

See the Battery and Transmitter IFU for implant instructions.

4.1 IMPLANT PROCEDURE PRECAUTIONS

Note: Patients should have an external defibrillator attached. Ensure that any co-implant anti-tachy therapies are disabled or reprogrammed to avoid having the co-implant deliver anti-tachy therapy. This also ensures that periprocedural pacing with the WiSE CRT System is not sensed by the co-implant's detection algorithms. After the procedure, ensure that anti-tachy therapies are enabled in the co-implant.

- Implant the Electrode using the associated Delivery Sheath (**Section 1**).
- Procedure requires that the patient be sufficiently anticoagulated to protect against thromboembolism.
- Components of the Electrode delivery system contain lumens that contain air. Use caution and diligence in ensuring that lumens are flushed with sterile fluids and maintain positive pressure to prevent the introduction of air into the vascular system.

- The distal end of the Delivery Sheath in the Electrode delivery system is tipped with a non-compliant balloon. This balloon is intended to increase the safety of the use of the device by reducing the likelihood that the Delivery Sheath may damage or puncture the vessels or the heart wall. The balloon must be inflated after advancement through the 12 F femoral introducer or transseptal sheath, but prior to contacting the heart wall.
- During the implant of the Electrode, there are key safety mitigations that must be followed by the operator. Specifically for Electrode delivery system manipulations, the operator must fluoroscopically verify the position of the Electrode delivery system relative to the ventricular wall with puffs of contrast to avoid excessive forces that might damage the cardiac tissue.

  Note: Do not rely solely on tactile feedback to assess contact with the ventricular wall.

Do the following to ensure the safe and effective implant of the Electrode:

1. Use real time imaging, such as ICE or TEE to assess the location of the delivery system relative to cardiac anatomy and to assess for pericardial effusion.
2. ~~With a perpendicular fluoroscopic view of the Delivery Sheath balloon, assess the location of the Delivery Sheath relative to the left ventricular wall~~ Adjust the fluoroscopic angle to achieve a side-on or perpendicular view of the Delivery Sheath balloon, assess the location of the Delivery Sheath relative to the left ventricular wall.
3. Monitor the intracardiac electrogram to assess current of injury (COI).
4. Never advance the Delivery Sheath within the left ventricle without fluoroscopic guidance using contrast dye injections to verify the position of the Delivery Sheath relative to the endocardial border.
5. Never maneuver the Delivery Sheath within the left ventricle without fluoroscopically confirming that the distal needle tip of the Electrode remains 1 cm proximal to the distal end of the Delivery Sheath.

   Note**:** The following observations are potential precursors to a pericardial effusion and must be acted upon as described below:

   - Outward bulging of the ventricular wall - Retract the delivery system to ease excess pressure.
   - Persistent myocardial tissue staining after contrast injection - Immediately assess for early signs of pericardial effusion through real time imaging by ICE or TEE. If no effusion, move the delivery system to a new location.
     Do not attempt to implant the Electrode in this location.
   - Placement of the delivery system in a deep channel within the endocardial wall, as indicated via fluoroscopy or real time imaging – Immediately withdraw the delivery system from the deep channel and assess for early signs of pericardial effusion. If no effusion, move the delivery system to a new location.
     Do not attempt to implant the Electrode in this location.
   - Avoid the following to ensure the safe and effective implant of the Electrode:
     - Do not detach the Electrode unless stable; secure endocardial wall anchoring can be observed using Cine review from a minimum of two orthogonal fluoroscopy angles captured at a minimum rate of 15 frames/sec.

Commented [AS1]: It is not clear what "perpendicular" means with respect to fluroscopic view. We normally talk about LAO and RAO views. Please clarify what is intended here.

Commented [SG2R1]: EBR has updated the language to provide clarity.

- Do not cross a prosthetic aortic valve during a retro aortic approach while implanting the Electrode.
- Do not cross a prosthetic mitral valve during a transseptal approach while implanting the Electrode.
- Carefully position the delivery system to avoid the implanted electrode interfering with the mitral valve apparatus.

4.2 Summary of Steps to Implant Electrode in the Left Ventricle

- Opening sterile containers
- Priming and flushing the Delivery Sheath and pigtail catheter
- Priming and flushing the Delivery Sheath balloon
- Obtaining access to the left ventricle
- Priming and flushing the Electrode Catheter
- Electrical connections and electrogram set-up
- Positioning the Electrode delivery system within the left ventricle
- Evaluating a site in the left ventricle
- Anchoring the Electrode
- Detaching the Electrode
- Releasing the Electrode

Each of these procedures are described in detail below.

4.3 Opening Sterile Containers

The WiSE CRT Electrode delivery system comes in two separate trays within sterile, peel-away pouches:

- WiSE CRT Electrode Catheter M1000 (Electrode and Catheter)
- WiSE CRT Delivery Sheath M2000 (Delivery Sheath)

Perform the following steps to ensure safe handling onto the sterile field:

1. Check the device package for the expiry date. Do not use devices that are past the expiry date marked on the package.
2. Remove the pouch containing the Delivery Sheath from one outer box package and remove the pouch containing the Electrode Catheter from the second outer box package.
3. Remove the registration materials from the outer boxes. Refer to the WiSE CRT Programmer M5100 (Model 5100) IFU for completion instructions.
4. Check the label on the pouch to ensure that the device name and model number match the required device.

5. Inspect the device package for damage. Do not use the device if the packaging is damaged, the seals are open, or the packaging is wet. Return any package to EBR that does not appear to present a sterile barrier.
6. Locate the accessible corner of the pouch, grip the peelable edge, and peel back the cover.
7. Using sterile technique, remove the sterile tray from the peel away pouch and place it onto the sterile field.

4.4 Priming and Flushing the Delivery Sheath and Pigtail Catheter

1. Connect the extension line onto the pigtail catheter.
2. Inject saline into the BLUE flush port of the pigtail extension line until fluid exits the distal end of the pigtail.
3. Inject saline into the BLUE flush port of the Delivery Sheath until the fluid is visibly dripping from the distal end of the Delivery Sheath.
4. Insert the guidewire into the pigtail catheter valve and advance until the tip of the guidewire is out of the tip of the pigtail.
5. Using the insertion tool, insert the pigtail catheter assembly into the Delivery Sheath, lock the insertion tool in this position by a ¼ clockwise turn, and advance the pigtail catheter assembly to the distal end of the Delivery Sheath.
6. Flush the Delivery Sheath after insertion of the catheter using the BLUE flush port, then close stopcock.

4.5 Priming and Flushing the Delivery Sheath Balloon

The balloon at the distal end of the Delivery Sheath reduces the risk of damage or puncture of the vessels and the heart wall. To remove any residual air, the balloon must be primed with diluted contrast prior to use.

1. Locate the RED inflation port and stopcock valve connected to the Delivery Sheath handle.
2. Locate the inflation pressure gauge integrated into the Delivery Sheath handle.
3. Connect the provided 3-ml syringe to the RED inflation port. Aspirate with the syringe to create a vacuum while gently squeezing down on the balloon with your fingers.
4. Close the RED stopcock valve.
5. Load the 3-ml syringe with sterile diluted fluoroscopic contrast dye (maximum of 50% dilution with sterile saline) then re-connect the 3-ml syringe to the RED inflation port.
6. Open the RED stopcock valve and inject the diluted contrast into the RED inflation port until the BLACK seal visible in the handle moves within the GREEN zone of the pressure gauge. Close the RED stopcock valve.
7. Visually inspect the balloon to ensure it is fully inflated. If not fully inflated and the RED port is closed, use another Delivery Sheath.
8. Visually inspect the balloon for the presence of air bubbles. If any residual bubbles are present, repeat the previous Steps 3 through 7.

Note: In addition to the visual inspection, the distal end of the Delivery Sheath can be placed into the fluoro field and using fluoroscopy, the contrast fill of the balloon can be checked. If the balloon is not clearly discernible via fluoroscopy, repeat the previous Steps 3 through 7.

9. Open the stopcock valve and aspirate with the syringe to create a vacuum while gently squeezing down on the balloon with your fingers.
10. Visually inspect the balloon to ensure that it is fully deflated.
11. Leave the stopcock valve open but keep the syringe connected to the RED inflation port.
12. The Delivery Sheath and pigtail catheter are now primed and ready for insertion into the introducer sheath.

    Note: Prior to insertion, connect one pressurized drip line to the pigtail catheter and ensure that positive pressure/ flow is observed. Optionally, an additional pressurized drip line can be connected directly to the Delivery Sheath.

4.6 Obtaining Access to the Left Ventricle

The Electrode delivery system may access the left ventricle via an arterial retrograde aortic approach or a venous transseptal approach.

Precaution: Do not attempt to manipulate the Delivery Sheath without the pigtail catheter or the Electrode Catheter in the Delivery Sheath. Manipulating an empty Delivery Sheath will potentially kink/ damage the shaft. The general steps for obtaining access and positioning the Electrode delivery system using the **Arterial Retrograde Approach** are as follows:

1. Use an arterial closure device that is suitable for use with a 12 F introducer sheath. Follow the closure device manufacturer's IFU.
2. Percutaneously insert a 12 F introducer sheath into the patient's femoral artery following the manufacturer's IFU for the introducer.
3. Under fluoroscopy, insert the Delivery Sheath assembly through the 12 F introducer valve; advance the guidewire approximately 20 cm out of the distal end of the introducer sheath. Advance the Delivery Sheath until the distal end of the Delivery Sheath is in the artery and is clear of the distal end of the introducer sheath.
4. Inflate the Delivery Sheath balloon by injecting diluted contrast (maximum of 50% dilution with sterile saline) with the 3-ml syringe into the RED inflation port until the distal end of the BLACK seal moves to within the GREEN zone in the pressure gauge.
5. Close the inflation stopcock valve.
6. Under fluoroscopy, check that the balloon is fully inflated and that the Delivery Sheath and introducer sheath are in-line with the vessel; i.e., there is no kink in the introducer sheath or Delivery Sheath.

   Note: If the balloon does not inflate or is not visible, withdraw the Delivery Sheath assembly completely through the introducer using fluoroscopic guidance and repeat steps from **Section 4.5**.
7. Advance the guidewire, followed by the delivery system around the aortic arch. Retract the guidewire so that it is completely inside the catheter. Advance and prolapse the pigtail tip of the catheter and advance across the aortic valve into the left ventricle. If the catheter will not cross

the valve, advance the guidewire through the valve, then advance the catheter into the ventricle. Advance the Delivery Sheath over the catheter into the left ventricle.

Note: Using echocardiography and/or fluoroscopy, carefully monitor the position of the guidewire, catheter, and Delivery Sheath whilst accessing the left ventricle. During access to the left ventricle, do not allow the guidewire, catheter, or Delivery Sheath to contact the free wall of the left ventricle.

8. Position the Delivery Sheath into the free chamber of the left ventricle ensuring that the Delivery Sheath is not against the wall.

   Note: Real time echocardiographic imaging of the left ventricle must also be used to assist with identifying the Delivery Sheath position relative to cardiac structures that may impede the manipulation of the Delivery Sheath.

9. Check that no deflection has been applied to the steering mechanism of the Delivery Sheath. If any deflection has been applied, remove by rotating the knob counterclockwise.

10. Slowly pull back the catheter and guidewire together until the distal end of the catheter is visible within the Delivery Sheath handle and stop.

11. Unlock the insertion tool by a ¼ counterclockwise turn from the Delivery Sheath handle. Then remove the insertion tool, the catheter, and guidewire together.

12. Ensure one pressurized, heparinized-saline drip line is connected to the Delivery Sheath at 1 drip per second.

    Note: The insertion tool opens the stasis valve in the Delivery Sheath. Extracting the catheter from the insertion tool will lose stasis of the Delivery Sheath. Back-flush blood if air is observed in the lumen.

The general steps for obtaining access and positioning the Electrode delivery system using the **Venous Transseptal Approach** are as follows:

1. Using standard percutaneous techniques, prepare the femoral vein for access, using a closure device if desired.

2. Use a standard, commercially available 12 F ID transseptal access system to cross the interatrial septum via an anterior transseptal puncture and gain access to the left atrium per the device IFU.

3. Using echocardiography and fluoroscopy, advance the deflectable portion of the transseptal sheath completely through the mitral valve and confirm the distal end of the transseptal sheath is not in contact with any cardiac structures or the LV wall.

4. Ensure one pressurized, heparinized-saline drip line is connected to the Delivery Sheath at 1 drip per second.

5. Insert the Delivery Sheath assembly through the transseptal access system valve. Advance the Delivery Sheath until the distal end of the Delivery Sheath is clear of the distal end of the transseptal sheath by 1-2 cm.

6. Inflate the Delivery Sheath balloon by injecting diluted contrast (maximum of 50% dilution with sterile saline) with the 3-ml syringe into the RED inflation port until the distal end of the BLACK seal moves to within the GREEN zone in the pressure gauge.

7. Under fluoroscopy check that the balloon is fully inflated.

Note: If the balloon does not inflate or is not visible, withdraw the Electrode delivery system completely through the transseptal sheath using fluoroscopic guidance and repeat steps from **Section 4.5**.

Note: If a catheter and/or guidewire were used, slowly pull back the catheter and guidewire together until the distal end of the catheter is visible within the Delivery Sheath handle and stop. Unlock the insertion tool by a ¼ counterclockwise turn from the Delivery Sheath handle. Then remove the insertion tool, the catheter, and guidewire together.

8. Using both echocardiography and fluoroscopy, confirm the Delivery Sheath is not in contact with any cardiac structures or the LV wall.

   Note: Real time echocardiographic imaging of the left ventricle must be used to assist with identifying the Delivery Sheath position relative to cardiac structures that may impede the manipulation of the Delivery Sheath.

   Note: The insertion tool opens the stasis valve in the Delivery Sheath. Extracting the catheter from the insertion tool will lose stasis of the Delivery Sheath. Back-flush blood if air is observed in the lumen.

4.7 Priming and Flushing the Electrode Catheter

1. Remove the blue Electrode protection cap from the distal end of the insertion tool located on the distal end of the Electrode Catheter.
2. Retract the insertion tool and inspect the Electrode to ensure all five tines of the anchor are visible and that there is no damage to the needle tip.
3. Inject saline into the BLUE flush port of the Electrode Catheter until the fluid is visibly dripping from the Electrode at the distal end.
4. Carefully advance the insertion tool over the Electrode and flush until saline exits the distal end of the insertion tool.
5. Connect a drip line with a heparinized saline IV pressure bag to the manifold and flush.
6. Connect a contrast drip line or syringe of contrast to the manifold.
7. Connect a manifold to the BLUE flush port of the Electrode Catheter and set to 1 drip per second.
8. Remove the cable protection plug from the back end of the Electrode Catheter handle.

Note: Contrast injections are made through the Electrode Catheter via the manifold, NOT the Delivery Sheath.

4.8 Electrical Connections and Electrogram Setup

Figure 3 shows the cathode of the Electrode located at the tip of the anchor that extends from the Electrode.

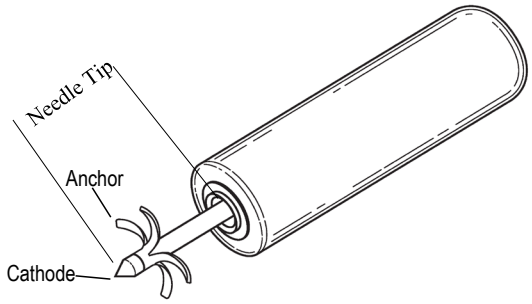


Figure 3. WiSE CRT Electrode

The Electrode Catheter contains an electrical connection to the cathode of the Electrode to evaluate whether a cardiac site is suitable for implanting the Electrode. The reference needle electrode, supplied with the delivery system provides a far-field reference electrode for recording a unipolar electrogram from the cathode, referred to as the intracardiac electrogram.

1. Remove the protective cap and insert the BLACK reference needle electrode superficially into anesthetized tissue near the femoral access of the introducer and connect the cable to electrogram monitoring and pacing instrument.
2. Connect one end of the RED extension cable to the mating connector at the handle of the Electrode Catheter and then connect the other end of the extension cable to electrogram monitoring and pacing instrument.

   Note: Monitor the intracardiac electrogram for a local electrogram to provide information related to the presence of endocardial scar or fibrosis and activation timing at the implant site. Also monitor the electrogram for current of injury to assess contact of the Delivery Sheath to the wall during maneuvering of the delivery system, both before and after anchoring of the Electrode into the tissue.

   - Current of injury: Suggested band-pass filter settings for assessing current of injury are 0.5 Hz to 1000 Hz.
   - Local electrogram: Suggested band pass filter settings for a local electrogram are 30 Hz to 1000 Hz.

4.9 Positioning the Delivery System within the Left Ventricle

The Delivery Sheath is deflectable in a single plane. A knob to control the deflection of the distal end of the Delivery Sheath is located on the handle. Rotate the knob clockwise to deflect and rotate the knob counterclockwise to straighten the Delivery Sheath.

Precaution: Do not attempt to manipulate the Delivery Sheath without the catheter or the Electrode Catheter in the Delivery Sheath. Manipulating an empty Delivery Sheath will potentially kink the shaft.

Precaution: When using a transseptal approach, if the deflectable portion of the Delivery Sheath is within the transseptal sheath, do NOT apply any deflection to the Delivery Sheath.

Note: When positioning the Electrode delivery system within the left ventricle, note the following:

- Always observe Delivery Sheath and Electrode Catheter movement using fluoroscopic and real time echocardiography imaging when deflecting, advancing, or retracting the system.
- When advancing the delivery system to the wall, prior to contacting the wall, fluoroscopic contrast media must be manually injected from the manifold through the Electrode Catheter to monitor the distal end of the Delivery Sheath relative to the wall.

  Note: Do not use a power injector system to inject contrast through the Electrode Catheter.

  During positioning of the Delivery Sheath, observe the intracardiac electrogram to assess contact of the Delivery Sheath to the wall and to assess the viability of tissue at the position.
- If the Delivery Sheath does not respond to deflection or advancement, assess the location of the distal end relative to the left ventricle wall using both contrast and real time echocardiographic imaging. The Delivery Sheath movement may be inhibited by chordae or papillary muscle structures requiring retraction prior to further maneuvering.
- Fluoroscopic contrast media must be manually injected to monitor the apposition of the tip of the Delivery Sheath relative to the wall by evaluating the flow of contrast from the tip of the Delivery Sheath. The flow of contrast may indicate tight contact (little or no flow), partial contact (eccentric flow), or no contact (full flow).
- Delivery Sheath deflection beyond 90° reduces the force that can be applied during anchoring and should be avoided.
- Visually ensure that the distal needle tip of the Electrode is always kept 1 cm proximal to the distal end of the Delivery Sheath when maneuvering to a target implant site.

  Note: Fluoroscopy or Cine should be used to document and review the following key stages:

  - Outline of LV wall – Fluoroscopy only
  - Initial proximity to LV wall – Fluoroscopy only
  - Seal against the LV wall – Fluoroscopy and Cine review

1. Prior to inserting the Electrode Catheter into the Delivery Sheath ensure that the button side of the handle faces upward toward the operator and the BLUE and ORANGE buttons are visible throughout the procedure.

   Note: Turning the handle later in the procedure will cause unwanted, additional torque to the Electrode delivery system.

2. Using the insertion tool, insert the Electrode Catheter into the Delivery Sheath valve. Lock the insertion tool in this position with a ¼ clockwise turn.

   Note: The Delivery Sheath valve or the Electrode may be damaged if the insertion tool is not properly inserted into the Delivery Sheath. Ensure the Electrode, including the needle, is completely within the lumen of the insertion tool prior to inserting the insertion tool into the Delivery Sheath valve. Hold the insertion tool, not the Electrode Catheter shaft, when inserting the insertion tool into the Delivery Sheath valve.

3. Advance the Electrode Catheter into the Delivery Sheath handle and check for any air that may have been introduced in the exchange. If air bubbles in the Delivery Sheath handle are observed; open the Delivery Sheath handle's BLUE stopcock valve to back flush out any air bubbles. Only when no air bubbles are observed, continue with advancing the Electrode Catheter.

4. Using fluoro, advance the Electrode Catheter within the Delivery Sheath until the Electrode's needle tip is 1 cm proximal to the distal end of the Delivery Sheath.

   Note: Never advance the Delivery Sheath within the left ventricle without fluoroscopically confirming that the Electrode's needle tip is 1 cm proximal of the distal end of the Delivery Sheath. **Continuously confirm by fluoroscopy that the needle tip does not inadvertently advance while maneuvering the Delivery Sheath within the left ventricle.** Advancing the Delivery Sheath with the Electrode's needle tip more distal may increase the risk of cardiac perforation.

   The Electrode may move distally relative to the Delivery Sheath when deflecting (steering) the Delivery Sheath. Always confirm that the Electrode's needle tip remains ≥ 1 cm proximal to the distal end of the Delivery Sheath while deflecting the Delivery Sheath.

5. Prior to any maneuvering of the transseptal sheath or delivery system:
   a. Assess the intracardiac electrogram to confirm Delivery Sheath is NOT in contact with the left ventricular wall.
   b. Using echocardiography and fluoroscopy with contrast, confirm the Delivery Sheath is NOT in contact with the left ventricular wall.
6. In an anterior-posterior (AP) fluoroscopy view, position the Electrode behind the Transmitter and confirm Electrode tracking.
7. Adjust C-arm fluoroscopic view and optimize echocardiography imaging of transseptal sheath and delivery system.
8. Apply required rotation and/or deflection on transseptal sheath (transseptal approach) or delivery system directly.

   Note: When using a transseptal approach, if the deflectable portion of the Delivery Sheath is within the transseptal sheath, do not apply any deflection to the Delivery Sheath.
9. Using fluoroscopy, apply puffs of contrast while slowly advancing delivery system toward the left ventricular wall.
10. When the balloon is in contact with the left ventricular wall, achieve a side-on, non-foreshortened fluoro view of the Delivery Sheath balloon.
11. Optimize echocardiographic imaging to view position of Delivery Sheath balloon.

    Note: Confirm that the Delivery Sheath is not in a deep tissue channel via frame-by-frame review of Cine recorded contrast injections and echocardiography.
12. Inject contrast with Cine recording at a minimum acquisition rate of 15 frames/sec. Assess the recording for left ventricular wall contact. Little or no flow indicates tight contact, eccentric flow indicates partial contact, and full flow indicates no contact.

13. If tight contact cannot be achieved, adjust the angulation of the Delivery Sheath relative to the wall and repeat the previous step.
14. If it is not possible to adjust the Delivery Sheath angulation to achieve tight contact, retract the Delivery Sheath away from the wall and maneuver to another potential implant site starting with Step 4 of this section.
15. If tight contact with a stable Delivery Sheath has been confirmed move on to evaluating a site in the left ventricle.

4.10 Evaluating a Site in the Left Ventricle

The steps below describe how to map the left ventricle to locate the optimal Electrode implant location.

1. Magnify the fluoro image onto the distal end of the Delivery Sheath.
2. Ensure fluoro image is providing a non-foreshortened view of the Delivery Sheath balloon, if not, adjust C-Arm position.
3. Using fluoro, slowly advance the Electrode needle so it is flush with the distal edge of the Delivery Sheath balloon.
4. Evaluate the position of the Electrode relative to the Transmitter using the M5100 Programmer.
5. The distance should be less than 12 cm and the targeting angle less than 45°. Nominal conditions for operating parameters assume < 10 cm distance between the Transmitter and the Electrode and angulations of no more than 30°. See the WiSE CRT Programmer M5100 IFU (LBL-05303) for additional information about making these measurements.

   Note: Expect significant reduction in anticipated Battery life or poor capture performance at ranges and angles outside of these nominal conditions.
6. Evaluate the intracardiac electrogram amplitude and morphology for any signs of fractionated or low amplitude indicating the presence of scar.
7. Measure the pre-anchor pacing threshold. The threshold should be ≤ 2.5 V for a 0.5 ms pulse width.

   Note: Accurate threshold assessment requires the correct pacing polarity with the cathode negative relative to the reference needle electrode.
8. Perform and record measurement of left ventricular activation time; e.g., QLV or LVAT
9. If results of the intracardiac electrogram, show that the Electrode position and pacing threshold are acceptable, continue with Section 4.11.
10. If the Electrode position or pacing threshold are not acceptable, first retract the Electrode so that the needle tip is 1 cm proximal to the distal end of the Delivery Sheath, then retract the delivery system away from the endocardial wall and evaluate another potential implant site starting with Step 9 of **Section 4.9**.

    Note: To avoid damaging the left ventricle wall, do not reposition the Delivery Sheath with the Electrode needle protruding from the distal end of the Sheath. Always keep the distal tip of the Electrode needle 1 cm proximal to the distal end of the Delivery Sheath while repositioning the Delivery Sheath within the left ventricle.

4.11 ANCHORING THE ELECTRODE

The Electrode has an anchor on the distal end of its needle designed to permanently attach the device in the tissue. When the implant site has been determined, the Electrode is actively fixed to the tissue by pushing the Electrode Catheter forward within the Delivery Sheath, but never to the point that more than 25% of the Electrode body is beyond the distal end of the Delivery Sheath. The Electrode is then detached from the Electrode Catheter and released from the delivery system.

Warning: Ensure the Electrode has been properly anchored to the ventricular wall to avoid embolization and patient harm.

1. Apply maximum magnification on the fluoroscopic image onto the distal end of the Delivery Sheath. Ensure that Electrode and Delivery Sheath balloon still appear in profile rather than foreshortened.
2. With the Delivery Sheath stabilized, under Cine recording at a minimum acquisition rate of 15 frames/sec, provide a slow but constant injection of contrast through the Electrode Catheter while slowly advancing the Catheter forward to observe possible tenting of tissue followed by puncture of the endocardium by the needle.

   Note: Review each Cine recording frame by frame to assess tenting. Maintain stability of both the Delivery Sheath and Electrode Catheter throughout the anchoring process and when reviewing Cines to prevent any unwanted movement of the Delivery Sheath or Electrode Catheter.
3. Continue to slowly advance the Electrode 1 mm at a time, using contrast injections and Cine recording, until the Electrode appears fully anchored.
4. To verify anchoring in first view, under Cine recording at a minimum acquisition rate of 15 frames/sec, inject contrast through the Electrode Catheter and verify the Electrode is anchored by confirming the absence of contrast in the needle zone and that the needle is beyond the endocardial boundary; i.e., zero tenting of the endocardium.

   Note: Maintain the position of the Electrode within the Delivery Sheath throughout the anchoring process. **Do not extend the body of the Electrode more than 25% past the end of the Delivery Sheath during anchoring.** If the Electrode cannot be confirmed to be anchored when no more than 25% of the body is beyond the end of the Delivery Sheath, and it has been confirmed that the Delivery Sheath balloon is still in contact with the LV wall, then the entire Delivery Sheath and Electrode Catheter may be slowly advanced together, until confirmation that the Electrode is fully anchored. Extending the body of the Electrode more than 25% beyond the end of the Delivery Sheath during anchoring may increase the risk of perforation or prevent the adequate assessment of anchoring.
5. To verify a fully anchored electrode, a second orthogonal view must be used. Under Cine recording at a minimum acquisition rate of 15 frames/sec, inject contrast through the Electrode Catheter and verify the Electrode is anchored by confirming the absence of contrast in the needle zone and that the needle is beyond the endocardial boundary; i.e., zero tenting of the endocardium.
6. Verify the post anchor threshold. The capture threshold should be ≤ 2 V for a 0.5 ms pulse width. Sometimes transient current of injury after anchoring prevents thresholds below 2 V. If the pacing threshold is between 2 V and 3 V, a downward trend over a 5-minute period can be used to indicate an acceptable pacing threshold.

7. If the pacing threshold is not acceptable, de-anchor the Electrode following these steps:

    a. Maintaining the Delivery Sheath position; retract the Electrode back into Delivery Sheath.

    Note: If a previously anchored Electrode is subsequently de-anchored, it cannot be re-implanted. A new Electrode must be used for subsequent implants.

    b. Retract the delivery system away from the endocardial wall and then remove the Electrode Catheter from the Delivery Sheath.

    c. Insert a new Electrode Catheter starting with Step 1 of **Section 4.7**.

Note: After extracting the Electrode Catheter from the Delivery Sheath, push the Electrode Catheter forward beyond the insertion tool and inspect the end of the Electrode Catheter to confirm that the Electrode is present.

4.12 DETACHING THE ELECTRODE

After confirming anchoring of the Electrode, the Electrode must be detached from the Electrode Catheter (**Figure 4**). During this process, if the appearance of the Electrode and the Electrode delivery system on fluoroscopy indicate that the Electrode is not stable and still securely anchored to the ventricular wall, do not detach the Electrode, do not attempt to reposition or to insert the Electrode into the tissue. The Electrode should be removed and replaced as described in **Section 4.11**.

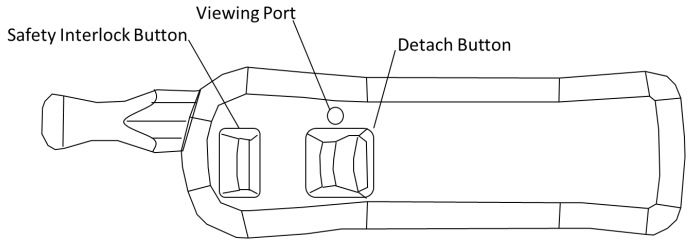


Figure 4. Electrode Catheter Handle – Top View

1. Stabilize Delivery Sheath and Electrode Catheter to prevent any additional forward force applied during the detach step. It is important that the delivery system does not move during the detachment.
2. Under Cine, slide the BLUE safety interlock button forward on the Electrode Catheter with right thumb.
3. Under Cine, with controlled, sustained force, push the ORANGE detach button forward with right thumb, until a color indicator change can be seen.
    - The viewing port next to the detach button will change color (from GREEN to ORANGE) as confirmation that the Electrode has detached.

- Alternatively, confirmation of detachment can be verified by the fully proximal position of the ORANGE circular boss in the side port (**Figure 5**).

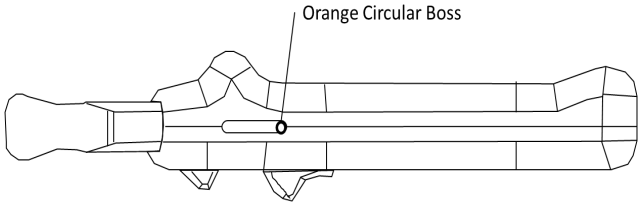


Figure 5. Electrode Catheter Handle – Side View

4. Confirm Electrical spike/ interference on EGM was observed. This confirms that electrical connection between Catheter and Electrode has been broken.

Note: To confirm a fully detached Electrode, both the color indicator change/ boss location change AND the Electrical spike/ interference on electrogram (EGM) must be observed.

Once detachment is complete, there is no connection between the Electrode Catheter and the Electrode. The Electrode is still in the Delivery Sheath, but you can no longer retrieve the Electrode by pulling back on the Electrode Catheter.

4.13 RELEASING THE ELECTRODE

Note: If using a transseptal sheath via transseptal approach, prior to performing the release step, a 2nd person must stabilize the transseptal sheath. This prevents any unwanted interaction between the sheaths during the release phase.

To release the Electrode from within the Delivery Sheath:

1. Maintain the Electrode Catheter position (do not move the Electrode Catheter).

2. Under Cine, slowly retract the Delivery Sheath ONLY, until the balloon has completely de-sheathed the Electrode and is aligned with the distal end of the Catheter. Hand movement is left hand to right hand.

3. Once the Electrode is released and clear of the end of the delivery system, retract both the Delivery Sheath and the Catheter together. Hand movement is both hands away to the right together. Ensure the Delivery Sheath and Catheter are cleared away from the Electrode in a continuous smooth motion.

4. Retract the Catheter so that it is at least 1 cm inside the Delivery Sheath.

5. Remove any deflection on the Delivery Sheath.

6. Deflate Delivery Sheath balloon by opening the stopcock and pulling back on the 3-ml syringe plunger. It will take several seconds for the balloon to deflate.

Note: If using the arterial retrograde approach, deflate the balloon after the delivery system is proximal to the aortic valve.

Note: If using the transseptal approach, deflate the balloon prior to withdrawing it back into the

transseptal sheath. The balloon must be fully deflated prior to removing the delivery system through the introducer. If significant resistance is felt while removing the Delivery Sheath, check that the balloon has fully deflated on fluoroscopy.

7. Withdraw the Delivery Sheath and Catheter together out of the patient.

   Cine should be used to document and review the following key stages:

   - De-sheathing
   - Release of Electrode
   - Post-anchor Electrode position and stability in RAO and LAO fluoro projections

5 CLEANING AND DISPOSAL OF DEVICES

The delivery system consists of single-use disposable devices and should be disposed of by following the facility's procedures for handling of medical waste. In the event a device needs to be returned to EBR, contact EBR for appropriate materials to return the devices.

Do not attempt to sterilize or reuse an implantable WiSE CRT device if it has previously been implanted in another patient.

6 MRI SAFETY INFORMATION

Refer to the Common Section IFU (LBL-05300) for MRI Safety Information for the implanted Electrode of the WiSE CRT System.

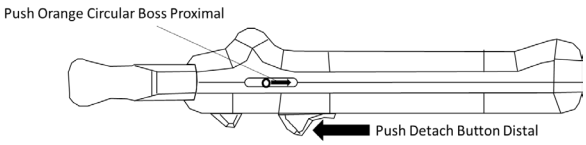
7 SYMBOL GLOSSARY

Refer to the Common Section IFU (LBL-05300) for an explanation of the symbols found on the product or the product label for the Electrode Catheter (M1000) and Delivery Sheath (M2000) of the WiSE CRT System.

8 TROUBLESHOOTING

ISSUE DESCRIPTION	POSSIBLE CAUSE	TROUBLESHOOTING AND CORRECTIONS
No Intracardiac Electrogram or Pacing with the Electrode Delivery System	Connection to the Electrode is disconnected in the Catheter or the Extension Cable is not connected.	• Check connections. • Replace cable and retry. • Withdraw Electrode Catheter and replace.
Unable to Determine Electrode Location using M5100	Transient conditions (e.g., residual air in transmitter pocket, electronic	• Remove external noise sources. • Ensure patient 100% RV paced.

ISSUE DESCRIPTION	POSSIBLE CAUSE	TROUBLESHOOTING AND CORRECTIONS
Programmer due to limited or No Electrode Tracking	interference, etc.) may prevent ultrasound transmission or effective sensing.	• Ensure correct Transmitter settings are programmed, e.g., TL6 at 1.0 ms and optimal targeting parameters. • If Transmitter is receiving low tracking signal level, the red and black cables can be shorted together to increase signal. • If tracking is not possible: WiSE CRT Programmer Model 5100 IFU (LBL-03886) contains instructions for determining the distance and angle using the Programmer
Unknown If Electrode Has Completely Detached	Increased friction between components of the handle assembly.	Follow the below steps to assess for detachment confirmation after each step: • Scan the prior EGM signal for discontinuity. • Check orange circular boss (**Figure 5**), if not fully proximal re-advance the detach button (**Figure 4**). • If orange circular boss is not proximal, inspect the Delivery Sheath for kinks. • Remove the delivery system, or alternatively proceed to below manual detach option. <u>Manual Detach:</u> • While maintaining the position of the Electrode Catheter and Delivery Sheath, as shown below in **Figure 6**, push and hold the orange detach button forward and, at the same time, insert a tool such as a standard pacing hex wrench, forceps, or similar, into the side port to engage the orange circular boss and slide the feature proximal. The distal tip of the tool should be approximately 1 mm diameter and 7 mm long to engage the boss. Afterwards, release detach button and verify the orange circular boss remains fully proximal. • If proximal, proceed to release the electrode from the Delivery Sheath per the IFU.

ISSUE DESCRIPTION	POSSIBLE CAUSE	TROUBLESHOOTING AND CORRECTIONS
		• If not proximal, withdraw the Electrode delivery system.
 **Figure 6. Electrode Catheter Handle Side View**		
Removing a Detached Electrode: Necessary to Remove the Delivery System with the Electrode Still Attached to the Catheter or with the Electrode Unattached but Still within the Delivery Sheath	Increased friction between components of the handle assembly.	• Ensure that the Electrode is in the Delivery Sheath. If necessary, carefully pull the Catheter and advance the Delivery Sheath to ensure the Electrode is captured. • Immediately turn off the positive pressure drip lines. Do not flush or inject fluid or dye as this may eject the Electrode from the Delivery Sheath. • If the Electrode is not attached to the Catheter, pull very slightly on the Catheter to create a vacuum in the distal end of the Delivery Sheath to assist with holding the Electrode in place. This action may have the desirable effect of drawing the Electrode further into the Delivery Sheath. • After the system is past the aortic valve into the aorta (for arterial retrograde) or past the mitral valve in the left atrium (for transseptal), deflate the balloon by opening the red stopcock and pulling back on the 3-ml syringe plunger. It will take several seconds for the balloon to deflate. The balloon must be fully deflated prior to removing the system through the introducer. If significant resistance is felt while removing the Delivery Sheath, check that the balloon has deflated. • Remove the entire Electrode delivery system by pulling the Delivery Sheath back through the introducer. Do not pull the Catheter back through the Delivery Sheath. • Withdraw the entire Electrode delivery system through the introducer using fluoroscopic guidance.

Unable to Withdraw the Delivery System through the Introducer	Balloon is not adequately deflated	• Remove the sterile diluted fluoroscopic contrast dye via negative pressure from the 3-ml syringe which is connected to the red inflation port. This will take several seconds and may require the process to be repeated. • Ensure 3-ml syringe is connected to the red inflation port. Aspirate with the syringe to create a vacuum. • Under fluoroscopy, check that the balloon is fully deflated prior to withdrawing the delivery system through the introducer.

9 TECHNICAL SPECIFICATIONS

9.1 PHYSICAL, ELECTRICAL, AND MATERIAL SPECIFICATIONS

ELECTRODE (M1000)	
Volume	0.05 ml
Body Length	9.2 mm
Diameter	2.8 mm
Mass	126 mg
Cathode Area-Material	0.9 mm^2 - Iridium Oxide
Anode Area-Material	82 mm^2 - Titanium
Cathode-Reference Needle Electrode Impedance	1200 Ω (nominal)
Cathode-Anode Spacing	2.8 mm
Voltage Output Limit (Nominal)	2.8 V
Needle/ Anchor Length	3.5 mm
Patient Contact Materials	Titanium, Polyester, Ruby, Gold, Platinum/Iridium, PEEK, Nitinol, Epoxy, Silicone, Iridium Oxide

DELIVERY SYSTEM (ELECTRODE CATHETER M1000 AND DELIVERY SHEATH M2000)	
Effective Length Sheath (M2000)	109.5 cm
Effective Length Catheter (M1000 with Electrode)	124 cm
Length of Deflectable Section	15 cm
Max Deflection	120° (minimum)

DELIVERY SYSTEM (ELECTRODE CATHETER M1000 AND DELIVERY SHEATH M2000)	
Curve Radius at 90°	6.5 cm (inner radius)
Max Sheath Outer Diameter	4.0 mm/ 12 F
Max Balloon Diameter	8 mm
Max Balloon Pressure	496 kPa
Max Rated Injection Pressure Pigtail Catheter	800 kPa
Max Rated Injection Pressure Sheath	400 kPa
Max Rated Injection Pressure Electrode Catheter	800 kPa
Luer Fittings to External Devices	ISO 80369-7
Extension Cable Length	3 meters
Reference Needle Electrode Length	49 mm
Connector Type	Touch Protected 1.5 mm (DIN 42802)
Reference Needle Electrode Gauge	22
Patient Contact Materials	Pebax, 300 Series Stainless Steel, Silicone, Polycarbonate, Polyimide, Polyethylene terephthalate, High Density Polyethylene, Polypropylene, PVC, PTFE, Nylon, ABS, Polyester, Solder, Cyanoacrylate, Acrylated Urethane Acetyl, Copolyester