

**Boston
Scientific**

PULSE GENERATOR USER'S MANUAL

EMBLEM™ S-ICD

Subcutaneous Implantable Cardioverter Defibrillator

MODEL A209

CAUTION: Federal law (USA) restricts this device to sale by or on the order of a physician trained or experienced in device implant and follow-up procedures.

EMBLEM is a trademark of Boston Scientific.

This product may be protected by one or more patents. Patent information can be obtained at <http://www.bostonscientific.com/patents>.

List of Acronyms

ATP	Anti-tachycardia pacing
BOL	Beginning of life
CPR	Cardiopulmonary resuscitation
CRT	Cardiac resynchronization therapy
DFT	Defibrillation threshold
EAS	Electronic article surveillance
ECG	Electrocardiogram
EGM	Electrogram
EIT	Electrode insertion tool
EMI	Electromagnetic interference
EOL	End of life
ERI	Elective replacement indicator
ESWL	Extracorporeal shock wave lithotripsy
FCC	Federal Communications Commission
HBOT	Hyperbaric oxygen therapy
MRI	Magnetic resonance imaging
NSR	Normal sinus rhythm
PVC	Premature ventricular contraction
S-ECG	Subcutaneous electrocardiogram
S-ICD	Subcutaneous implantable cardioverter defibrillator
SVT	Supraventricular tachycardia
TENS	Transcutaneous electrical nerve stimulation
VF	Ventricular fibrillation
VT	Ventricular tachycardia

Table of Contents

Description	1
Related Information	1
Intended Audience	1
Indications for Use	1
Contraindications	1
Warnings	1
General	1
Handling	2
Implantation	2
Post-Implant	3
Precautions	3
Clinical Considerations	3
Sterilization and Storage	4
Implantation	4
Device Programming	5
Environmental and Medical Therapy Hazards	6
Hospital and Medical Environments	6
Home and Occupational Environments	10
Follow-up Testing	12
Explant and Disposal	12
Supplemental Precautionary Information	12
Potential Adverse Events	13
Clinical Summary	15
S-ICD System Clinical Investigation	15
Methods	15
Primary Objectives	15
Additional Objectives	16
Accountability of PMA Cohort	17
Study Population Demographics and Baseline Parameters	18

Safety and Effectiveness Results	24
Effectiveness Results	32
Subgroup Analyses	35
Conclusion	36
Patient Screening	37
Collecting the Surface ECG	37
Evaluating the Surface ECG	38
Determining an Acceptable Sense Vector	40
Operation	41
General	41
Modes of Operation	41
Shelf Mode	41
Therapy On Mode	41
Therapy Off Mode	41
Sensing Configuration and Gain Selection	42
Sensing and Tachyarrhythmia Detection	42
Detection Phase	42
Certification Phase	43
Decision Phase	43
Therapy Zones	43
Analysis in the Conditional Shock Zone	44
Charge Confirmation	45
Therapy Delivery	45
Smart Charge	45
Redetection	46
Shock Waveform and Polarity	46
Post-Shock Bradycardia Pacing Therapy	46
Manual and Rescue Shock Delivery	46
Additional Features of the S-ICD System	46
Auto Capacitor Reformation	47
Internal Warning System – Beeper Control	47

Arrhythmia Induction	47
System Diagnostics	47
Subcutaneous Electrode Impedance	48
Device Integrity Check	48
Battery Performance Monitoring System	48
Storing and Analyzing Data	49
Treated Episodes	49
Untreated Episodes	49
Captured S-ECG	49
S-ECG Rhythm Strip Markers	50
Patient Data	51
S-ICD System Magnet Use	52
Magnet use for patients with deep implant placement	53
Magnet Response and Pulse Generator Mode	54
Bidirectional Torque Wrench	55
Using the EMBLEM S-ICD Pulse Generator	55
Items Included in Package	55
Implanting the S-ICD System	56
Check Equipment	56
Interrogate and Check the Pulse Generator	57
Creating the Device Pocket	57
Implanting the EMBLEM S-ICD Subcutaneous Electrode	58
Connecting the Subcutaneous Electrode to the Device	61
Setting up the EMBLEM S-ICD Pulse Generator using the Model 3200 S-ICD Programmer	65
Defibrillation Testing	66
Complete and Return the Implantation Form	67
Patient Counseling Information	68
Patient Guide	68
Post Implant Follow-Up Procedures	69
Explantation	70
Loosening Stuck Setscrews	71

Communication Compliance	72
Federal Communications Commission (FCC) Compliance	72
Additional Information	72
Product Reliability	72
Pulse Generator Longevity	73
Specifications	74
X-ray Identifier	74
Definitions of Package Label Symbols	81
S-ICD System and Pacemaker Interaction	83
Warranty Information	84

Description

The EMBLEM™ S-ICD pulse generator (the “device”) is a component of the Boston Scientific S-ICD System, which is prescribed for patients when cardiac arrhythmia management is warranted. The pulse generator accepts one EMBLEM S-ICD subcutaneous electrode with an SQ-1 S-ICD connector.¹ The EMBLEM S-ICD pulse generator is also compatible with the Cameron Health Model 3010 Q-TRAK subcutaneous electrode.

The pulse generator and subcutaneous electrode constitute the implantable portion of the S-ICD System. The pulse generator can be used only with the EMBLEM S-ICD programmer Model 3200 and Model 3203 telemetry wand.

Related Information

For additional information about other components of the S-ICD System, refer to the following:

- EMBLEM S-ICD Subcutaneous Electrode User’s Manual
- EMBLEM S-ICD Subcutaneous Electrode Insertion Tool User’s Manual
- EMBLEM S-ICD Programmer User’s Manual

Intended Audience

This literature is intended for use by professionals trained or experienced in device implant and/or follow-up procedures.

Indications for Use

The S-ICD System is intended to provide defibrillation therapy for the treatment of life-threatening ventricular tachyarrhythmias in patients who do not have symptomatic bradycardia, incessant ventricular tachycardia, or spontaneous, frequently recurring ventricular tachycardia that is reliably terminated with anti-tachycardia pacing.

Contraindications

Unipolar pacing and impedance-based features are contraindicated for use with the S-ICD System.

Warnings

General

- **Labeling knowledge.** Read this manual thoroughly before using the S-ICD System to avoid damage to the pulse generator and/or subcutaneous electrode. Such damage can result in patient injury or death.

¹ SQ-1 is a non-standard connector unique to the S-ICD System.

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- **For single patient use only.** Do not reuse, reprocess, or resterilize. Reuse, reprocessing, or resterilization may compromise the structural integrity of the device and/or lead to device failure which, in turn, may result in patient injury, illness, or death. Reuse, reprocessing, or resterilization may also create a risk of contamination of the device and/or cause patient infection or cross-infection, including, but not limited to, the transmission of infectious disease(s) from one patient to another. Contamination of the device may lead to injury, illness, or death of the patient.
 - **Component Compatibility.** All Boston Scientific S-ICD implantable components are designed for use with the Boston Scientific or Cameron Health S-ICD System only. Connection of any S-ICD System components to a non-compatible component will result in failure to deliver life-saving defibrillation therapy.
 - **Backup defibrillation protection.** Always have external defibrillation equipment and medical personnel skilled in CPR available during implant and follow-up testing. If not terminated in a timely fashion, an induced ventricular tachyarrhythmia can result in the patient's death.
 - **Pulse generator interaction.** Using multiple pulse generators could cause pulse generator interaction, resulting in patient injury or a lack of therapy delivery. Test each system individually and in combination to help prevent undesirable interactions. Refer to the S-ICD System and Pacemaker Interaction section on page 83 of this manual for more information.

Handling

- **Proper Handling.** Handle the components of the S-ICD System with care at all times and maintain proper sterile technique. Failure to do so may lead to injury, illness, or death of the patient.
- **Do not damage components.** Do not modify, cut, kink, crush, stretch or otherwise damage any component of the S-ICD System. Impairment to the S-ICD System may result in an inappropriate shock or failure to deliver therapy to the patient.
- **Handling the subcutaneous electrode.** Use caution handling the subcutaneous electrode connector. Do not directly contact the connector with any surgical instruments such as forceps, hemostats, or clamps. This could damage the connector. A damaged connector may result in compromised sealing integrity, possibly leading to compromised sensing, loss of therapy, or inappropriate therapy.

Implantation

- **System dislodgement.** Use appropriate anchoring techniques as described in the implant procedure to prevent S-ICD System dislodgement and/or migration. Dislodgement and/or migration of the S-ICD System may result in an inappropriate shock or failure to deliver therapy to the patient.

Post-Implant

- **Magnet Response.** Use caution when placing a magnet over the S-ICD pulse generator because it suspends arrhythmia detection and therapy response. Removing the magnet resumes arrhythmia detection and therapy response.
- **Magnet response with deep implant placement.** In patients with a deep implant placement (greater distance between the magnet and the pulse generator) magnet application may fail to elicit the magnet response. In this case the magnet cannot be used to inhibit therapy.
- **Diathermy.** Do not expose a patient with an implanted S-ICD System to diathermy. The interaction of diathermy therapy with an implanted S-ICD pulse generator or electrode can damage the pulse generator and cause patient injury.
- **Magnetic Resonance Imaging (MRI) exposure.** Do not expose a patient to MRI scanning. Strong magnetic fields may damage the pulse generator and/or subcutaneous electrode, possibly resulting in injury to or death of the patient.
- **Protected environments.** Advise patients to seek medical guidance before entering environments that could adversely affect the operation of the active implantable medical device, including areas protected by a warning notice that prevents entry by patients who have a pulse generator.
- **Sensitivity settings and EMI.** The pulse generator may be more susceptible to low frequency electromagnetic interference at induced signals greater than 80 μV . Oversensing of noise due to this increased susceptibility could lead to inappropriate shocks and should be taken into consideration when determining the follow-up schedule for patients exposed to low frequency electromagnetic interference. The most common source of electromagnetic interference in this frequency range is the power system for some European trains which operate at 16.6 Hz. Particular attention should be given to patients with occupational exposure to these types of systems.

Precautions

Clinical Considerations

- **Longevity.** Battery depletion will eventually cause the S-ICD pulse generator to stop functioning. Defibrillation and excessive numbers of charging cycles shorten the battery longevity.
- **Pediatric Use.** The S-ICD System has not been evaluated for pediatric use.
- **Available Therapies.** The S-ICD System does not provide long-term bradycardia pacing, cardiac resynchronization therapy (CRT) or anti-tachycardia pacing (ATP).

Sterilization and Storage

- **If package is damaged.** The blister trays and contents are sterilized with ethylene oxide gas before final packaging. When the pulse generator and/or subcutaneous electrode is received, it is sterile provided the container is intact. If the packaging is wet, punctured, opened, or otherwise damaged, return the pulse generator and/or subcutaneous electrode to Boston Scientific.
- **If device is dropped.** Do not implant a device which has been dropped while outside of its intact shelf package. Do not implant a device which has been dropped from a height of more than 24 inches (61 cm) while within its intact shelf package. Sterility, integrity and/or function cannot be guaranteed under these conditions and the device should be returned to Boston Scientific for inspection.
- **Use by date.** Implant the pulse generator and/or subcutaneous electrode before or on the USE BY date on the package label because this date reflects a validated shelf life. For example, if the date is January 1, do not implant on or after January 2.
- **Device storage.** Store the pulse generator in a clean area away from magnets, kits containing magnets, and sources of EMI to avoid device damage.
- **Storage temperature and equilibration.** Recommended storage temperatures are 0°C–50°C (32°F–122°F). Allow the device to reach a proper temperature before using telemetry communication capabilities, programming or implanting the device because temperature extremes may affect initial device function.

Implantation

- **Avoid shock at implant.** Verify the device is in Shelf mode or Therapy Off to prevent the delivery of unwanted shocks to the patient or the person handling the device during the implant procedure.
- **Evaluate patient for surgery.** There may be additional factors regarding the patient's overall health and medical condition that, while not related to device function or purpose, could render the patient a poor candidate for implantation of this system. Cardiac health advocacy groups may have published guidelines that may be helpful in conducting this evaluation.
- **Creating the subcutaneous tunnel.** Use only the electrode insertion tool to create the subcutaneous tunnel when implanting and positioning the subcutaneous electrode.
- **Suture location.** Suture only those areas indicated in the implant instructions.
- **Do not suture directly over subcutaneous electrode body.** Do not suture directly over the subcutaneous electrode body, as this may cause structural damage. Use the suture sleeve to prevent subcutaneous electrode movement.

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- **Do not bend the subcutaneous electrode near the electrode-header interface.** Insert the subcutaneous electrode connector straight into the pulse generator header port. Do not bend the subcutaneous electrode near the subcutaneous electrode-header interface. Improper insertion can cause insulation or connector damage.
 - **Subcutaneous Electrode connections.** Do not insert the subcutaneous electrode into the pulse generator connector port without taking the following precautions to ensure proper insertion:
 - › Insert the torque wrench into the preslit depression of the seal plug before inserting the subcutaneous electrode connector into the port, to release any trapped fluid or air.
 - › Visually verify that the setscrew is sufficiently retracted to allow insertion. Use the torque wrench to loosen the setscrew if necessary.
 - › Fully insert the subcutaneous electrode connector into the port and then tighten the setscrew onto the connector.
 - **Sternal wires.** When implanting the S-ICD system in a patient with sternal wires, ensure that there is no contact between the sternal wires and the distal and proximal sense electrodes (for example, by using fluoroscopy). Compromised sensing can occur if metal-to-metal contact occurs between a sense electrode and a sternal wire. If necessary, re-tunnel the electrode to ensure sufficient separation between the sense electrodes and the sternal wires.
 - **Replacement device.** Implanting a replacement device in a subcutaneous pocket that previously housed a larger device may result in pocket air entrapment, migration, erosion, or insufficient grounding between the device and tissue. Irrigating the pocket with sterile saline solution decreases the possibility of pocket air entrapment and insufficient grounding. Suturing the device in place reduces the possibility of migration and erosion.
 - **Telemetry wand.** The wand is a non-sterile device. Do not sterilize the wand or programmer. The wand must be contained in a sterile barrier before use in the sterile field.

Device Programming

- **Device communication.** Use only the designated programmer and software application to communicate with the S-ICD pulse generator.
- **Sensing adjustment.** Following any sensing parameter adjustment or any modification of the subcutaneous electrode, always verify appropriate sensing.
- **Patients hear tones coming from their device.** Patients should be advised to contact their physician immediately whenever they hear beeping tones coming from their device.

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- **Programming for supraventricular tachyarrhythmias (SVTs).** Determine if the device and programmed parameters are appropriate for patients with SVTs because SVTs can initiate unwanted device therapy.

Environmental and Medical Therapy Hazards

- **Avoid electromagnetic interference (EMI).** Advise patients to avoid sources of EMI because EMI may cause the pulse generator to deliver inappropriate therapy or inhibit appropriate therapy. Moving away from the source of the EMI or turning off the source usually allows the pulse generator to return to normal operation. Examples of potential EMI sources are:
 - › Electrical power sources, arc welding or resistance welding equipment, and robotic jacks
 - › High voltage power distribution lines
 - › Electrical smelting furnaces
 - › Large RF transmitters such as radar
 - › Radio transmitters, including those used to control toys
 - › Electronic surveillance (antitheft) devices
 - › An alternator on a car that is running
 - › Medical treatments and diagnostic tests in which an electrical current is passed through the body, such as TENS, electrocautery, electrolysis/thermolysis, electrodiagnostic testing, electromyography, or nerve conduction studies
 - › Any externally applied device that uses an automatic lead detection alarm system (e.g., an EKG machine)

Hospital and Medical Environments

- **External defibrillation.** External defibrillation or cardioversion can damage the pulse generator or subcutaneous electrode. To help prevent damage to implanted system components, consider the following:
 - › Avoid placing a pad (or paddle) directly over the pulse generator or subcutaneous electrode. Position the pads (or paddles) as far from the implanted system components as possible.
 - › Set energy output of external defibrillation equipment as low as clinically acceptable.
 - › Following external cardioversion or defibrillation, verify pulse generator function ("Post-Therapy Pulse Generator Follow-Up" on page 12).

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- **Cardiopulmonary resuscitation.** Cardiopulmonary resuscitation (CPR) may temporarily interfere with sensing and may cause delay of therapy.
 - **Electrical interference.** Electrical interference or “noise” from devices such as electrocautery and monitoring equipment may interfere with establishing or maintaining telemetry for interrogating or programming the device. In the presence of such interference, move the programmer away from electrical devices, and ensure that the wand cord and cables are not crossing one another.
 - **Ionizing Radiation.** It is not possible to specify a safe radiation dosage or guarantee proper pulse generator function following exposure to ionizing radiation. Multiple factors collectively determine the impact of radiation therapy on an implanted pulse generator, including proximity of the pulse generator to the radiation beam, type and energy level of the radiation beam, dose rate, total dose delivered over the life of the pulse generator, and shielding of the pulse generator. The impact of ionizing radiation will also vary from one pulse generator to another and may range from no changes in function to a loss of therapy.

Sources of ionizing radiation vary significantly in their potential impact on an implanted pulse generator. Several therapeutic radiation sources are capable of interfering with or damaging an implanted pulse generator, including those used for the treatment of cancer, such as radioactive cobalt, linear accelerators, radioactive seeds, and betatrons.

Prior to a course of therapeutic radiation treatment, the patient’s radiation oncologist and cardiologist or electrophysiologist should consider all patient management options, including increased follow-up and device replacement. Other considerations include:

- › Shield the Pulse Generator with a radiation-resistant material, regardless of the distance between the Pulse Generator and the radiation beam.
- › Determining the appropriate level of patient monitoring during treatment.

Evaluate pulse generator operation during and following the course of radiation treatment to exercise as much device functionality as possible (“Post-Therapy Pulse Generator Follow-Up” on page 12). The extent, timing, and frequency of this evaluation relative to the radiation therapy regimen are dependent upon current patient health, and therefore should be determined by the attending cardiologist or electrophysiologist.

Pulse generator diagnostics are performed automatically once per hour, so pulse generator evaluation should not be concluded until pulse generator diagnostics have been updated and reviewed (at least one hour after radiation exposure). The effects of radiation exposure on the implanted pulse generator may remain undetected until some time following exposure. For this reason, continue to monitor pulse generator function closely and use caution when programming a feature in the weeks or months following radiation therapy.

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- **Electrocautery and Radio Frequency (RF) Ablation.** Electrocautery and RF ablation may induce ventricular arrhythmias and/or fibrillation, and may cause inappropriate shocks and inhibition of post-shock pacing. Additionally, exercise caution when performing any other type of cardiac ablation procedure in patients with implanted devices. If electrocautery or RF ablation is medically necessary, observe the following to minimize risk to the patient and device:
 - › Program the pulse generator to Therapy Off mode.
 - › Have external defibrillation equipment available.
 - › Avoid direct contact between the electrocautery equipment or ablation catheters and the pulse generator and subcutaneous electrode.
 - › Keep the path of the electrical current as far away as possible from the pulse generator and subcutaneous electrode.
 - › If RF ablation and/or electrocautery is performed on tissue near the device or subcutaneous electrode, verify pulse generator function ("Post-Therapy Pulse Generator Follow-Up" on page 12).
 - › For electrocautery, use a bipolar electrocautery system where possible and use short, intermittent, and irregular bursts at the lowest feasible energy levels.

When the procedure is finished, return the pulse generator to Therapy On mode.

- **Lithotripsy.** Extracorporeal shock wave lithotripsy (ESWL) may cause electromagnetic interference with or damage to the pulse generator. If ESWL is medically necessary, consider the following to minimize the potential for encountering interaction:
 - › Avoid focusing the lithotripsy beam near the pulse generator implant site.
 - › Program the pulse generator to Therapy Off mode to prevent inappropriate shocks.
- **Ultrasound energy.** Therapeutic ultrasound (e.g., lithotripsy) energy may damage the pulse generator. If therapeutic ultrasound energy must be used, avoid focusing near the pulse generator site. Diagnostic ultrasound (e.g., echocardiography) is not known to be harmful to the pulse generator.
- **Radio frequency (RF) interference.** RF signals from devices that operate at frequencies near that of the pulse generator may interrupt telemetry while interrogating or programming the pulse generator. This RF interference can be reduced by increasing the distance between the interfering device and the programmer and pulse generator.
- **Conducted electrical current.** Any medical equipment, treatment, therapy, or diagnostic test that introduces electrical current into the patient has the potential to interfere with pulse generator function. Medical therapies, treatments, and diagnostic tests that use conducted electrical current (e.g., TENS, electrocautery, electrolysis/thermolysis, electrodiagnostic testing, electromyography, or nerve conduction studies) may interfere with or damage the pulse generator. Program the device to Therapy

Off mode prior to the treatment, and monitor device performance during the treatment. After the treatment, verify pulse generator function ("Post-Therapy Pulse Generator Follow-Up" on page 12).

- **Transcutaneous Electrical Nerve Stimulation (TENS).** TENS involves passing electrical current through the body, and may interfere with pulse generator function. If TENS is medically necessary, evaluate the TENS therapy settings for compatibility with the pulse generator. The following guidelines may reduce the likelihood of interaction:
 - › Place the TENS electrodes as close together and as far away from the pulse generator and subcutaneous electrode as possible.
 - › Use the lowest clinically-appropriate TENS energy output.
 - › Consider cardiac monitoring during TENS use.

Additional steps can be taken to help reduce interference during in-clinic use of TENS:

- › If interference is suspected during in-clinic use, turn off the TENS unit.
- › Do not change TENS settings until you have verified that the new settings do not interfere with pulse generator function.

If TENS is medically necessary outside the clinical setting (at-home use), provide patients with the following instructions:

- › Do not change the TENS settings or electrode positions unless instructed to do so.
- › End each TENS session by turning off the unit before removing the electrodes.
- › If the patient receives a shock during TENS use, they should turn off the TENS unit and contact their physician.

Follow these steps to use the programmer to evaluate pulse generator function during TENS use:

1. Program the pulse generator to Therapy Off mode.
2. Observe real-time S-ECGs at prescribed TENS output settings, noting when appropriate sensing or interference occurs.
3. When finished, turn off the TENS unit and reprogram the pulse generator to Therapy On mode.

You should also perform a thorough follow-up evaluation of the pulse generator following TENS, to ensure that device function has not been compromised ("Post Therapy Pulse Generator Follow-Up" on page 12).

For additional information, contact Boston Scientific using the information on the back cover.

Home and Occupational Environments

- **Home appliances.** Home appliances that are in good working order and properly grounded do not usually produce enough EMI to interfere with pulse generator operation. There have been reports of pulse generator disturbances caused by electric hand tools or electric razors used directly over the pulse generator implant site.
- **Electronic Article Surveillance (EAS) and Security Systems.** Advise patients to avoid lingering near or leaning against antitheft and security gates or tag readers that include radio frequency identification (RFID) equipment. These systems may be found at the entrances and exits of stores, in public libraries, and in point-of-entry access control systems. These systems are unlikely to affect cardiac device function when patients walk through them at a normal pace. If the patient is near an electronic antitheft, security, or entry control system and experiences symptoms, they should promptly move away from nearby equipment and inform their doctor.
- **Cellular phones.** Advise patients to hold cellular phones to the ear opposite the side of the implanted device. Patients should not carry a cellular phone that is turned on in a breast pocket or on a belt within 15 cm (6 inches) of the implanted device since some cellular phones may cause the pulse generator to deliver inappropriate therapy or inhibit appropriate therapy.
- **Magnetic fields.** Advise patients that extended exposure to strong (greater than 10 gauss or 1 mTesla) magnetic fields may suspend arrhythmia detection. Examples of magnetic sources include:
 - › Industrial transformers and motors
 - › MRI scanners
 - › Large stereo speakers
 - › Telephone receivers if held within 1.27 cm (0.5 inches) of the pulse generator
 - › Magnetic wands such as those used for airport security and in the Bingo game
- **Elevated Pressures.** The International Standards Organization (ISO) has not approved a standardized pressure test for implantable pulse generators that experience hyperbaric oxygen therapy (HBOT) or SCUBA diving. However, Boston Scientific developed a test protocol to evaluate device performance upon exposure to elevated atmospheric pressures. The following summary of pressure testing should not be viewed as and is not an endorsement of HBOT or SCUBA diving.

Elevated pressures due to HBOT or SCUBA diving may damage the pulse generator. During laboratory testing, all pulse generators in the test sample functioned as designed when exposed to more than 300 cycles at a pressure up to 3.0 ATA. Laboratory testing did not characterize the impact of elevated pressure on pulse generator performance or physiological response while implanted in a human body.

Pressure for each test cycle began at ambient/room pressure, increased to a high pressure level, and then returned to ambient pressure. Although dwell time (the amount of time under elevated pressure) may have an impact on human physiology, testing indicated it did not impact pulse generator performance. Pressure value equivalencies are provided below (Table 1 on page 11).

Table 1: Pressure Value Equivalencies

Pressure value equivalencies	
Atmospheres Absolute	3.0 ATA
Sea water depth ^a	20 m (65 ft)
Pressure, absolute	42.7 psia
Pressure, gauge ^b	28.0 psig
Bar	2.9
kPa Absolute	290

^a All pressures were derived assuming sea water density of 1030 kg/m³.

^b Pressure as read on a gauge or dial (psia = psig + 14.7 psi).

Prior to SCUBA diving or starting an HBOT program, the patient's attending cardiologist or electrophysiologist should be consulted to fully understand the potential consequences relative to the patient's specific health condition. A Dive Medicine Specialist may also be consulted prior to SCUBA diving.

More frequent device follow-up may be warranted in conjunction with HBOT or SCUBA diving. Evaluate pulse generator operation following high pressure exposure ("Post-Therapy Pulse Generator Follow-Up" on page 12). The extent, timing, and frequency of this evaluation relative to the high pressure exposure are dependent upon current patient health, and should be determined by the attending cardiologist or electrophysiologist. If you have additional questions, or would like more detail regarding the test protocol or test results specific to HBOT or SCUBA diving, contact Boston Scientific using the information on the back cover.

Follow-up Testing

- **Low shock impedance.** A reported shock impedance value of less than 25 ohms from a delivered shock could indicate a problem with the device. The delivered shock may have been compromised, and/or any future therapy from the device may be compromised. If a reported impedance value of less than 25 ohms is observed, correct functioning of the device should be verified.
- **Conversion testing.** Successful VF or VT conversion during arrhythmia conversion testing is no assurance that conversion will occur post-operatively. Be aware that changes in the patient's condition, drug regimen, and other factors may change the DFT, which may result in nonconversion of the arrhythmia post-operatively. Verify with a conversion test that the patient's tachyarrhythmias can be detected and terminated by the pulse generator system if the patient's status has changed or parameters have been reprogrammed.
- **Follow-up considerations for patients leaving the country.** Pulse generator follow-up considerations should be made in advance for patients who plan to travel or relocate post-implant to a country other than the country in which their device was implanted. Regulatory approval status for devices and associated programmer software configurations varies by country; certain countries may not have approval or capability to follow specific products. Contact Boston Scientific, using the information on the back cover, for help in determining feasibility of device follow-up in the patient's destination country.

Explant and Disposal

- **Device handling at explant.** Before explanting, cleaning, or shipping the device, complete the following actions to prevent unwanted shocks, overwriting of important therapy history data, and audible tones:
 - › Program the pulse generator to Therapy Off mode
 - › If ERI or EOL has been reached, disable the beeper.
 - › Clean and disinfect the device using standard biohazard handling techniques.
- **Incineration.** Be sure that the pulse generator is removed before cremation. Cremation and incineration temperatures might cause the pulse generator to explode.

Supplemental Precautionary Information

- **Post-Therapy Pulse Generator Follow-Up.** Following any surgery or medical procedure with the potential to affect pulse generator function, you should perform a thorough follow-up, which may include the following:
 - › Interrogating the pulse generator with a programmer

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- › Reviewing stored events, fault codes, and real-time S-ECGs prior to saving all patient data
 - › Testing the subcutaneous electrode impedance
 - › Verifying battery status
 - › Printing any desired reports
 - › Verifying the appropriate final programming prior to allowing the patient to leave the clinic
 - › Ending session

Potential Adverse Events

Potential adverse events related to implantation of the S-ICD System may include, but are not limited to, the following:

- Acceleration/induction of atrial or ventricular arrhythmia
- Adverse reaction to induction testing
- Allergic/adverse reaction to system or medication
- Bleeding
- Conductor fracture
- Cyst formation
- Death
- Delayed therapy delivery
- Discomfort or prolonged healing of incision
- Electrode deformation and/or breakage
- Electrode insulation failure
- Erosion/extrusion
- Failure to deliver therapy
- Fever
- Hematoma/seroma
- Hemothorax
- Improper electrode connection to the device
- Inability to communicate with the device
- Inability to defibrillate or pace

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- Inappropriate post shock pacing
 - Inappropriate shock delivery
 - Infection
 - Keloid formation
 - Migration or dislodgement
 - Muscle/nerve stimulation
 - Nerve damage
 - Pneumothorax
 - Post-shock/post-pace discomfort
 - Premature battery depletion
 - Random component failures
 - Stroke
 - Subcutaneous emphysema
 - Surgical revision or replacement of the system
 - Syncope
 - Tissue redness, irritation, numbness or necrosis

If any adverse events occur, invasive corrective action and/or S-ICD System modification or removal may be required.

Patients who receive an S-ICD System may develop psychological disorders that include, but are not limited to, the following:

- Depression/anxiety
- Fear of device malfunction
- Fear of shocks
- Phantom shocks

Clinical Summary

The following clinical summary is applicable to the EMBLEM S-ICD System. The study was conducted using the first generation version of the S-ICD System. The EMBLEM System provides the same therapies for the same indications as the system used in the study.

S-ICD System Clinical Investigation

The S-ICD System Clinical Investigation was a single-arm, prospective, non-randomized, multicenter clinical study conducted in patients age 18 or older who had an existing transvenous ICD, or who met guideline indications for ICD therapy, and had an appropriate pre-operative ECG. Patients with documented spontaneous and frequently recurring ventricular tachycardia (VT) that was reliably terminated with anti-tachycardia pacing were excluded unless they were not a candidate for a transvenous ICD system. The study was conducted at 33 participating centers (28 centers in the United States, 2 centers in The Netherlands, 2 centers in New Zealand and 1 center in The United Kingdom). A total of 330 patients were enrolled in the study, 321 underwent an implant procedure and 314 were implanted with the S-ICD System. The mean follow-up duration for all patients implanted was 330 days with a range of 17 to 715 days. Cumulative time of follow-up for all implanted patients was 3,410 months.

Methods

Clinical data were collected at the time of enrollment, implant, hospital discharge, follow-up visits, during system revisions, and upon notification of clinical events, study exit, or protocol deviations. All patients were scheduled to return for follow-up examinations after the implant procedure and pre-discharge follow-up at 30, 90 and 180 days post implant, and semi-annually thereafter. Data were collected via case report forms and programmer printouts. All centers followed the same Clinical Investigational Plan and methods to collect data.

Primary Objectives

The primary objectives of the study were:

- To confirm safety of the S-ICD System by demonstrating that the S-ICD System complication-free rate at 180 days post-implant meets or exceeds the performance goal of 79% with at least 95% confidence.
- To confirm effectiveness of the S-ICD System by demonstrating that the induced VF conversion rate meets or exceeds the performance goal of 88% with at least 95% confidence.

Additional Objectives

Additional objectives of the study were:

- To observe the continued chronic performance of the S-ICD System during appropriate device-detected episodes of VT or VF.
- To observe the continued chronic performance of the S-ICD System during induced episodes of VT or VF at least 150 days post-implant.

Accountability of PMA Cohort

Of 330 patients enrolled in PMA study, 321 underwent an implant procedure, of whom 314 were implanted with the S-ICD System. There were 293 patients still active at the time of database lock on February 14, 2012. The mean follow-up duration for all patients implanted was 330 days with a range of 17 to 715 days. Cumulative time of follow-up for all implanted patients was 3,410 months. The disposition of all study participants is summarized in Figure 1 below:

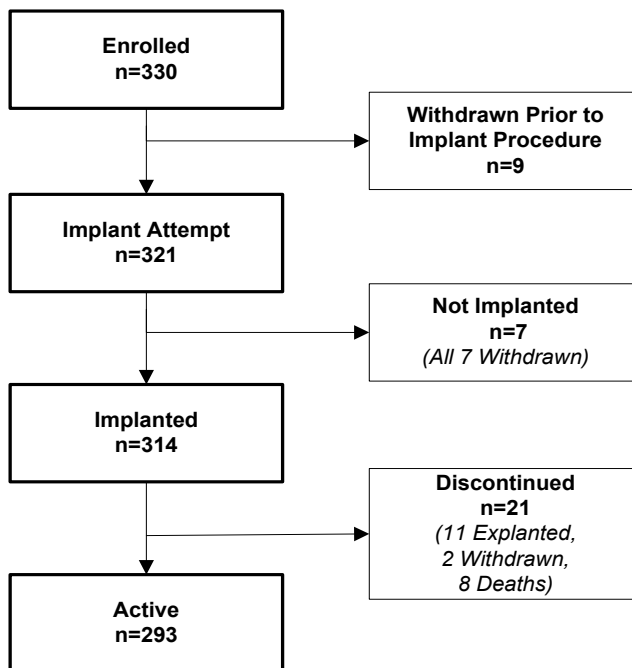


Figure 1: Summary of Patient Status as of 14 February, 2012

The primary safety endpoint analysis cohort includes all patients who underwent an implant attempt for the S-ICD System (N=321). The primary effectiveness endpoint cohort includes all patients undergoing an implant attempt with complete acute induced VF conversion tests (N=304). A total of 17 patients did not complete acute induced VF conversion testing as defined in the protocol. Seven of the 17 patients were ultimately not implanted due to difficulty converting VF at 65J. Ten of the 17 patients did not complete the protocol defined testing criteria but were implanted with the S-ICD System. Of these 10 patients, 6 patients experienced difficulty inducing VF, 3 patients had difficulty converting VF at 65J and 1 patient with a persistent LV thrombus was not tested.

Study Population Demographics and Baseline Parameters

The demographics and baseline characteristics of the study population are shown in Table 1 and Table 2, respectively. Cardiovascular history included congestive heart failure (61.4%), hypertension (58.3%), and myocardial infarction (41.4%).

All patients met ICD indications as described in Table 3. Primary prevention ICD indications represented 79.4% of the cohort. Additionally, the study population included patients indicated for implantation due to hypertrophic cardiomyopathy (8.7%), long-QT syndrome (3.7%), and Brugada syndrome (3.1%).

Table 2: Subject demographics

Demographic	Statistic/Category	N=321
Age (years)	Mean \pm SD (Median) Range	51.9 \pm 15.5 (53.8) 18.5-85.2
Gender (n, %)	Male	238 (74.1)
	Female	83 (25.9)

Demographic	Statistic/Category	N=321
Race (n, %)	White or Caucasian	208 (64.8)
	Black or African American	76 (23.7)
	Hispanic or Latino	23 (7.2)
	Asian	6 (1.9)
	Asian Indian	3 (0.9)
	Maori	3 (0.9)
	Pacific Islander	2 (0.6)
Height (cm)	Mean \pm SD (Median) Range	174.3 \pm 10.2 (175.0) 142.2-200.7
Weight (kg)	Mean \pm SD (Median) Range	90.5 \pm 25.2 (86.6) 42.6-230.9
BMI	Mean \pm SD (Median) Range	29.7 \pm 7.2 (29.0) 15.2-69.0

Table 3: Baseline Characteristics

Attribute	Statistic/Category	N=321
Creatinine (mg/dL)	Mean \pm SD (Median) Range	1.1 \pm 0.4 (1.0) 0.3-3.7
Ejection Fraction (%) (n=299)	Mean \pm SD (Median) Range	36.1 \pm 15.9 (31.0) 10.0-82.0
NYHA Classification at Enrollment (n, %)	I: No Physical Limitations	68 (21.2)
	II: Slight Physical Limitations	146 (45.5)
	III: Marked Physical Limitations	55 (17.1)
	IV: Total Physical Limitations	1 (0.3)
	Unknown/Not Assessed	51 (15.9)
Co-morbidities History (n, %)	Atrial Fibrillation	49 (15.3)
	COPD	27 (8.4)
	Cancer	31 (9.7)
	Congestive Heart Failure	197 (61.4)
	Diabetes	90 (28.0)

Attribute	Statistic/Category	N=321
Co-morbidities History (n, %)	Hypertension	187 (58.3)
	Myocardial Infarction	133 (41.4)
	Stroke	18 (5.6)
	Valve Disease	42 (13.1)
Cardiac Surgical History (n, %)	Ablation	16 (5.0)
	CABG	48 (15.0)
	Defibrillator	43 (13.4)
	Pacemaker	4 (1.2)
	Percutaneous Revascularization	92 (28.7)
	Valve Surgery	18 (5.6)

Table 4: Indications According to ACC/AHA/HRS Guidelines

Indication Details	N=321 Patients n (%)
Left ventricular ejection fraction (LVEF) less than 35% due to prior MI who are at least 40 days post-MI and are in NYHA functional Class II or III	88 (27.4)
Non-ischemic DCM and an LVEF less than or equal to 35% and is in NYHA functional Class II or III	76 (23.7)
Survivor of cardiac arrest due to VF or hemodynamically unstable sustained VT after evaluation to define the cause of the event and to exclude any completely reversible causes	40 (12.5)
Hypertrophic Cardiomyopathy with risk for SCD	28 (8.7)
Structural heart disease and spontaneous sustained VT, whether hemodynamically stable or unstable	15 (4.7)
Left Ventricular (LV) dysfunction due to prior MI and is at least 40 days post-MI, has an LVEF less than 30%, and is in NYHA functional Class I	13 (4.0)
Cardiomyopathy with risk for SCD	13 (4.0)
Long-QT syndrome with risk of SCD	12 (3.7)
Brugada syndrome with risk for SCD	10 (3.1)
Syncope of undetermined origin with clinically relevant, hemodynamically significant sustained VT or VF induced at electrophysiological study	7 (2.2)

Indication Details	N=321 Patients n (%)
Familial cardiomyopathy associated with SCD	6 (1.9)
Cardiac sarcoidosis or Chagas disease	4 (1.2)
Arrhythmogenic Right Ventricular Dysplasia/Cardiomyopathy (ARVD/C) with risk for SCD	3 (0.9)
Nonsustained VT due to prior MI, LVEF less than 40%, and inducible VF or sustained VT at electrophysiological study	2 (0.6)
LV noncompaction	1 (0.3)
Catecholaminergic polymorphic VT	1 (0.3)
Sustained VT and normal or near-normal ventricular function	1 (0.3)
Symptomatic ventricular arrhythmia	1 (0.3)

Safety and Effectiveness Results

Safety Results

The 180-day Type I complication-free rate was assessed in all patients with an attempted S-ICD System implant (N=321) for the primary safety endpoint. A Type I complication was defined as any clinical event caused by the S-ICD System that required invasive intervention.

The Type I complication-free rate at 180 days was 99.0% with a lower 95% confidence bound of 97.9%. These results meet the primary safety endpoint performance goal of 79% and demonstrate the safety of the S-ICD System. Details of the Kaplan-Meier analysis are shown in Figure 2 and Table 5.

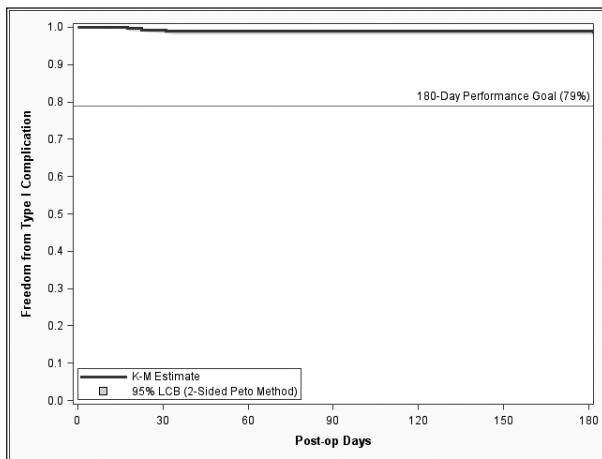


Figure 2: Primary Safety Endpoint Kaplan-Meier Analysis

Table 5: Kaplan-Meier Estimates for Primary Safety Endpoint

Statistic	Start of Interval (Days from Implant)				
	0	30	90	180	360
Number Remaining at Risk	319	311	308	274	119
Cumulative Patients Censored	2	8	10	44	194
Cumulative Patients with Events	0	2	3	3	8
KM Estimate of Patients Free from Event (%)	100	99.4	99.0	99.0	96.6
95% Lower Confidence Bound	100	98.5	98.0	97.9	93.5

Clinical Events

A Clinical Event is defined as any untoward medical occurrence in a patient. An Observation is a clinical event that does not result in invasive intervention and a Complication is a clinical event that results in invasive intervention. All clinical events were classified by type based on the cause of the clinical event, according to the following definitions:

- Type I: Caused by the S-ICD System
- Type II: Caused by the S-ICD System user's manual or labeling of the S-ICD System
- Type III: Not caused by the S-ICD System, but would not have occurred in the absence of the implanted S-ICD System
- Type IV: Caused by a change in the patient's condition

Table 6 summarizes all 211 clinical events reported from 139 patients, followed by a full listing of all Type I, II and III clinical events in Table 7, Table 8 and Table 9, respectively.

Table 6: *Clinical Event Summary by Type and Observation/Complication*

All patients with an implant attempt (N=321)

Clinical Event	Complications		Observations		Total	
	Events	Patients (%)	Events	Patients (%)	Events	Patients (%)
<u>Type I</u>	12 ^a	11 (3.4)	35	30 (9.3)	47	3 (12.1)
<u>Type II</u>	4	4 (1.2)	0	0 (0.0)	4	4 (1.2)
<u>Type III</u>	25	24 (7.5)	83	71 (22.1)	108	88 (27.4)
<u>Type IV</u>	16	15 (4.7)	36	33 (10.3)	52	44 (13.7)
All Clinical Events	57	48 (15.0)	154	116 (36.1)	211	139 (43.3)

^a Of note, there were a total of 12 Type I Complications throughout the entire follow-up duration. Three (3) occurred within 180 days of implant and are shown in the primary safety Kaplan-Meier analysis (Figure 2). Five (5) additional Type I complications were observed within 360 days of implant and the remaining four (4) occurred after 360 days post-implant.

Table 7: Type I Clinical Events

All patients with an implant attempt (N=321)

Clinical Event	Complications		Observations		Total	
	Events	Patients (%)	Events	Patients (%)	Events	Patients (%)
Discomfort	3	3 (0.9)	8	7 (2.2)	11	11 (3.4)
Inability to Communicate with the Device	2	2 (0.6)	0	0 (0.0)	2	2 (0.6)
Inappropriate Shock: Oversensing	5	5 (1.6)	25	21 (6.5)	30	25 (7.8)
Numbness at Device Site	0	0 (0.0)	1	1 (0.3)	1	1 (0.3)
Premature Battery Depletion	2	2 (0.6)	0	0 (0.0)	2	2 (0.6)
Subcutaneous Emphysema	0	0 (0.0)	1	1 (0.3)	1	1 (0.3)
All Type I Clinical Events	12	11 (3.4)	35	30 (9.3)	47	39 (12.1)

Table 8: *Type II Clinical Events*

All patients with an implant attempt (N=321)

Clinical Event	Complications		Observations		Total	
	Events	Patients (%)	Events	Patients (%)	Events	Patients (%)
Electrode Movement	2	2 (0.6)	0	0 (0.0)	2	2 (0.6)
Inappropriate Electrode Connection to the Device	1	1 (0.3)	0	0 (0.0)	1	1 (0.3)
Sub-optimal Electrode Position	1	1 (0.3)	0	0 (0.0)	1	1 (0.3)
All Type II Clinical Events	4	4 (1.2)	0	0 (0.0)	4	4 (1.2)

Table 9: Type III Clinical Events

All patients with an implant attempt (N=321)

Clinical Event	Complications		Observations		Total	
	Events	Patients (%)	Events	Patients (%)	Events	Patients (%)
Acute Hypoxic Respiratory Failure	0	0 (0.0)	1	1 (0.3)	1	1 (0.3)
Adverse Reaction to Medication	3	3 (0.9)	5	5 (1.6)	8	8 (2.5)
Atrial Fibrillation / Flutter	0	0 (0.0)	14	14 (4.4)	14	14 (4.4)
Bleeding	0	0 (0.0)	1	1 (0.3)	1	1 (0.3)
Discomfort	1	1 (0.3)	12	12 (3.7)	13	12 (3.7)
Electrode Movement	1	1 (0.3)	0	0 (0.0)	1	1 (0.3)
Fever	0	0 (0.0)	3	3 (0.9)	3	3 (0.9)
Hematoma	1	1 (0.3)	5	4 (1.2)	6	5 (1.6)
Inadequate/ Prolonged Healing of Incision Site	3	3 (0.9)	2	2 (0.6)	5	5 (1.6)

Clinical Event	Complications		Observations		Total	
	Events	Patients (%)	Events	Patients (%)	Events	Patients (%)
Inappropriate Shock: SVT Above Discrimination Zone (Normal Device Function)	4	4 (1.2)	17	14 (4.4)	21	16 (5.0)
Incision/Superficial Infection	1	1 (0.3)	13	13 (4.0)	14	14 (4.4)
Keloid	1	1 (0.3)	0	0 (0.0)	1	1 (0.3)
Local Tissue Reaction	0	0 (0.0)	1	1 (0.3)	1	1 (0.3)
Numbness at Device Site	0	0 (0.0)	1	1 (0.3)	1	1 (0.3)
PG Movement/Revision	1	1 (0.3)	0	0 (0.0)	1	1 (0.3)
Phantom Shock	0	0 (0.0)	5	3 (0.9)	5	3 (0.9)
Redness/Irritation	0	0 (0.0)	2	2 (0.6)	2	2 (0.6)
Stroke	0	0 (0.0)	1	1 (0.3)	1	1 (0.3)

Clinical Event	Complications		Observations		Total	
	Events	Patients (%)	Events	Patients (%)	Events	Patients (%)
Sub-optimal PG and Electrode Position	3	3 (0.9)	0	0 (0.0)	3	3 (0.9)
Sub-optimal Pulse Generator Position	1	1 (0.3)	0	0 (0.0)	1	1 (0.3)
Suspected Worsening of Ischemia	1	1 (0.3)	0	0 (0.0)	1	1 (0.3)
System Infection	4	4 (1.2)	0	0 (0.0)	4	4 (1.2)
All Type III Clinical Events	25	24 (7.5)	83	71 (22.1)	108	88 (27.4)

Device Explants

Eleven (11) patients exited the study after the S-ICD System was removed for: system infection (4), oversensing (2), premature battery depletion (1), transvenous device implanted to provide overdrive pacing for ventricular arrhythmia trigger suppression (1), elective explant due to the development of an indication for biventricular pacing (1), elective explant due to development of high defibrillation threshold (1), and elective due to patient request (1).

Patient Deaths

Eight (8) deaths occurred in the study. None of the deaths were conclusively identified to be associated with the device or procedure.

Effectiveness Results

The effectiveness of the S-ICD System was assessed by the proportion of patients with successful acute (induced) VF conversion in all patients with an attempted S-ICD System implant (N=320).² A successful VF conversion test required two consecutive VF conversions at 65 J from four induction attempts within a given shock polarity.

Of the 320 patients who underwent acute VF conversion testing, 16 patients³ yielded non-evaluable results due to incomplete protocol testing. Of the 304 evaluable results, the S-ICD System acute VF conversion success rate was 100% with a lower 95% confidence bound of 98.8% (Table 9). These results met the primary safety endpoint performance goal of 88% and demonstrate the effectiveness of the S-ICD System.

² One (1) patient did not undergo testing at the discretion of the investigator.

³ Nine (9) patients were implanted with the S-ICD System. Seven (7) patients with non-evaluable tests were not implanted. Five (5) of the seven (7) patients received a transvenous ICD and information regarding subsequent device implantation for two (2) patients is unknown.

Table 10: Effectiveness Endpoint Result - Acute VF Conversion Rate

Patients undergoing acute VF conversion testing (N=320)

Non-evaluable Results	Evaluable Results		Estimate (%)	95% Clopper-Pearson Interval (%)
	Successful	Failure		
16	304	0	100.0	(98.8-100.0)

Of the 16 non-evaluable patients, 11 were associated with at least one failed conversion attempt at 65 J and, due to physician discretion, did not exhaust all of the protocol defined induction attempts in both shock polarities. A sensitivity analysis was performed to impute these patients as failures despite incomplete testing, resulting in an imputed VF conversion success rate of 96.5%.

Spontaneous Episodes

A total of 119 spontaneous VT/VF episodes in 21 patients were treated by the S-ICD System through February 14, 2012. A VT/VF episode refers to a device-declared episode in which device rate/discrimination criteria were met in response to a ventricular tachyarrhythmia and therapy was delivered. A single episode may contain up to 5 shocks. The episode ends when the rolling average of the rate falls below the lowest programmed rate zone for 24 consecutive intervals.

For analysis, episodes were sub-divided into two classes: 1) discrete episodes that were temporally independent (<3 within 24 hours); and, 2) VT/VF storms that comprise 3 or more treated VT/VF episodes within 24 hours in the same patient. Of the 38 discrete device episodes, 35 (92.1%) were converted with the first shock and 37 (97.4%) were converted by any shock (Table 10). One episode terminated spontaneously after an unsuccessful first shock (MVT). Four (4) VT/VF storms from 2 patients resulted in 81 total device episodes, 40 of which were VF and stored in S-ICD System memory with the remaining 41 episodes not stored due to memory capacity limitations. Three (3) storms were ultimately converted by the S-ICD System and 1 was ultimately converted with an external defibrillation shock (Table 11). Of the 40 storm episodes with recorded data (53 total shocks), successful conversion following at least one shock from either shock polarity (shock 1 & 2) was 92.5%.

Table 11: Conversion Effectiveness of Discrete Device Episodes (non-Storm)

Patients with discrete episodes (N=21); Discrete device episodes (N=38)

Rhythm	Patients	Device Episodes	Episode Converted by 1st Shock (%)	Episode Converted by Any Shock(%)
MVT	13	22	21 (95.5)	21 (95.5)
PVT/VF	11	16	14 (87.5)	16 (100.0)
Total	21	38	35 (92.1)	37 (97.4)

Table 12: Conversion of VT/VF Storms

Patients with VT/VF Storms (N=2), Storm events (N=4), Stored Device episodes (N=40)

Patients	VT/VF Storms	Device Episodes	Final Storm Conversion Method (%)
2	4	40	S-ICD: 3 (75)
			External: 1 (25)
			Spontaneous Conversion: 0 (0)

Chronic Conversion Substudy

The chronic performance of the S-ICD System was assessed by the proportion of patients with successful conversion of induced VT/VF ≥ 150 days post-implant in all implanted patients who provided informed consent for this testing (N=78). Three (3) patients were excluded from the analysis because they met the pre-specified definition of a non-evaluable test (did not complete testing in the opposite polarity after a failed 65J shock, as required by the protocol). All three were converted with a subsequent 80J S-ICD System shock.

The rate of successful conversion by a sub-maximal (65J) S-ICD System shock was 72/75 (96.0%). All 3/75 (4.0%) patients who failed to convert with a sub-maximal (65J) S-ICD System shock in either polarity were successfully converted with a subsequent higher-energy S-ICD System shock.

Subgroup Analyses

Stepwise logistic regression models (backward elimination with a threshold p-value of 0.20) were used to evaluate basic demographic characteristics (age, gender, African American race) and baseline device programming (dual zone programming at hospital discharge) for statistical associations between with following safety-related outcomes:

- All Inappropriate shocks (n=41)
- Inappropriate shocks for oversensing (n=25)
- Inappropriate shocks for SVT (n=16)
- Discomfort (n=22)
- System and Superficial/Incision Infection (n=18)
- Type I-III Complications (n=35)

Age

Age was a significant predictor for inappropriate shocks. Patients who experienced inappropriate shocks were younger with a mean age of 47 compared to a mean age of 53 for patients who did not receive any inappropriate shocks.

Gender

Female gender was significantly associated with a higher risk for device or procedure related discomfort. Although the numbers are very small, it is notable that the inframammary crease was cited in 2 cases of female discomfort and the interface between the device site and the patient's bra was cited in another case.

Race

African American race was not associated with device or procedure related complications.

Dual Zone Programming at Discharge

Dual zone programming at the time of hospital discharge was associated with significantly fewer inappropriate shocks than those programmed with a single zone. There was a 70% relative reduction of incidence for inappropriate shocks due to SVT and a 56% relative reduction of incidence for inappropriate shocks due to oversensing, when compared to single zone programming.

Conclusion

The purpose of the S-ICD System Clinical Investigation was to evaluate the safety, effectiveness and chronic performance of the S-ICD System. There were 330 patients enrolled in the study and 321 underwent an implant procedure. The 314 patients implanted with the S-ICD System generated 3,410 months of patient data.

The data demonstrate that the S-ICD System operates appropriately per design for the S-ICD System's intended uses and as described in the S-ICD System's labeling. All objectives of the S-ICD System Clinical Investigation were met demonstrating safety and effectiveness of the S-ICD System.

Patient Screening

The patient screening tool, Model 4744 (Figure 3) is a customized measurement tool made of transparent plastic printed with colored profiles. The profiles are designed to ensure appropriate device performance by identifying signal characteristics that may lead to unsatisfactory detection outcomes for a patient before implant. The patient screening process is completed in three steps: (1) Collecting the surface ECG, (2) Evaluating the surface ECG and (3) Determining an acceptable sense vector.

The patient screening tool can be obtained from any Boston Scientific representative or by contacting Boston Scientific using the information on the back cover.

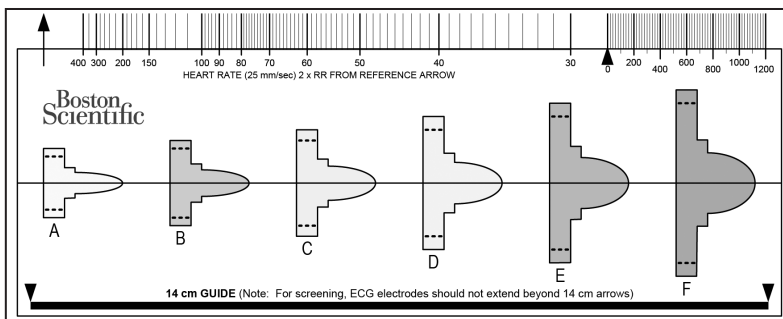


Figure 3: Patient Screening Tool. Each colored profile is assigned a letter (A,B,C,D,E,F) for ease of reference.

Collecting the Surface ECG

1. In order to perform the patient screening process, a surface equivalent of the subcutaneous sensing vectors must be obtained. It is important to collect the surface ECG in the location that represents the intended position of the implanted S-ICD System. When placing the S-ICD System in the typical implant location, the surface ECG electrode should be positioned as described below (Figure 4). If a non-standard S-ICD System subcutaneous electrode or pulse generator placement is desired, the surface ECG electrode locations should be modified accordingly.
 - **ECG Electrode LL** should be placed in a lateral location, at the 5th intercostal space along the mid-axillary line to represent the intended location of the implanted pulse generator.
 - **ECG Electrode LA** should be placed 1 cm left lateral of the xiphoid midline to represent the intended location of the proximal sensing node of the implanted subcutaneous electrode.

- **ECG Electrode RA** should be placed 14 cm superior to the ECG Electrode LA, to represent the intended position of the distal sensing tip of the implanted subcutaneous electrode. A 14 cm guide is located at the bottom of the transparent screening tool.

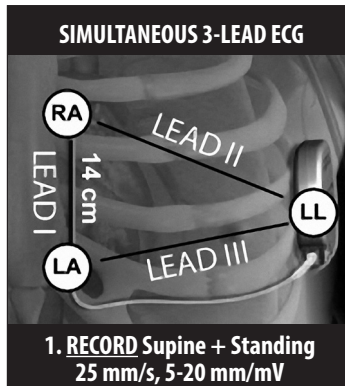


Figure 4: Typical placement of surface ECG electrodes for patient screening

2. Using a standard ECG machine, record 10 - 20 seconds of ECG using Leads I, II and III with a sweep speed of 25 mm/sec and ECG gain between 5 - 20 mm/mV (use the largest ECG gain that does not result in clipping).
Note: It is important to establish a stable baseline when collecting the surface ECG. If a wandering baseline is noted, ensure that the appropriate ground electrodes from the ECG machine are attached to the patient. To yield an acceptable signal for testing, the gain may be adjusted for each ECG lead independently.
3. Record ECG signals in at least two postures: (1) Supine and (2) Standing. Other postures may be collected including: Seated, Left Lateral, Right Lateral, and Prone.
Note: If the S-ICD System is to be implanted with a concomitant pacemaker, all ventricular morphologies (paced and intrinsic, if normal conduction is expected) should be collected.

Evaluating the Surface ECG

Each surface ECG should be evaluated by analyzing at least 10 seconds of QRS complexes. If multiple morphologies are noted (e.g., bigeminy, pacing, etc.), all morphologies should be tested as described below before the vector is deemed acceptable.

Each QRS complex is evaluated as follows:

1. **Select** the colored profile from the Patient Screening Tool that best matches the amplitude of the QRS (*Figure 5*). For biphasic signals, the larger peak should be used to determine the appropriate colored profile. The QRS peak must fall within the window bounded by the dotted line and the peak of the colored profile.

Note: ECG gains > 20 mm/mV are not permitted. If, when printed at the maximum 20 mm/mV gain, the QRS peak does not reach the minimum boundary (dotted line) of the smallest colored profile, that QRS complex is deemed unacceptable.

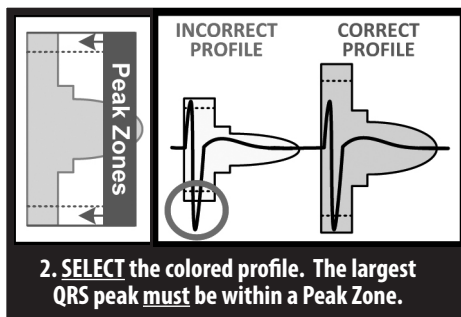


Figure 5: *Selecting the colored profile*

2. **Align** the left edge of the selected colored profile with the onset of the QRS complex. The horizontal line on the colored profile should be used as a guide for isoelectric baseline alignment.

3. **Evaluate** the QRS complex. If the entire QRS complex and trailing T-wave are contained within the colored profile, the QRS is deemed acceptable. If any portion of the QRS complex or trailing T-wave extends outside of the colored profile, the QRS is deemed unacceptable (*Figure 6*).

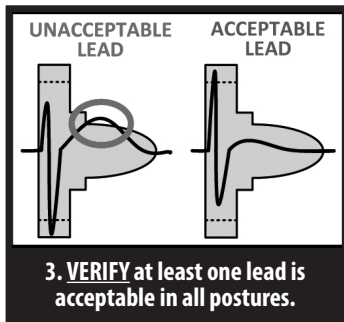


Figure 6: *Evaluating the QRS complex*

4. **Repeat** the above steps with all QRS complexes collected with all surface ECG leads in all collected postures.

Determining an Acceptable Sense Vector

Each collected surface ECG lead represents a sense vector of the S-ICD System. Evaluate each surface ECG lead independently for acceptability. A surface ECG lead (sense vector) should be deemed acceptable only if all of the following conditions are met:

- All tested QRS complexes and morphologies from the surface ECG lead (sense vector) must pass the QRS evaluation. Exceptions can be made for a large morphology change associated with an occasional ectopic beat (e.g. PVC).
- The morphology of the intrinsic/paced QRS complex is stable across postures. No significant change to the QRS complex is noted as a result of postural changes.
- The surface ECG lead (sense vector) must be deemed acceptable in all tested postures.

A patient is considered suitable for implant of the S-ICD System if at least one surface ECG lead (sense vector) is acceptable for all tested postures.

Note: *Special circumstances may present in which the physician elects to proceed with the implantation of the S-ICD System despite failing the screening process. In this case, careful attention should be applied to the device setup process of the S-ICD System as the risk of poor sensing and/or inappropriate shock is increased.*

Operation

General

The S-ICD System is designed for ease of use and simplicity of patient management. The arrhythmia detection system employs up to two rate zones, and the device has a single automatic response to a detected ventricular tachyarrhythmia – a nonprogrammable, maximum-energy, biphasic shock of 80 J. The device has a number of automatic functions designed to reduce the amount of time required for implantation, initial programming and patient follow-up.

Modes of Operation

The device has three modes of operation:

- Shelf
- Therapy On
- Therapy Off

Shelf Mode

The Shelf mode is a low power consumption state intended for storage only. When communication is initiated between the device and the programmer, a full-energy capacitor reformation is performed and the device is prepared for setup. Once the device is taken out of Shelf mode, it cannot be reprogrammed back into Shelf mode.

Therapy On Mode

The Therapy On mode is the primary operating mode of the device, allowing automatic detection of and response to ventricular tachyarrhythmias. All device features are active.

Note: *The device must be programmed out of Shelf mode before being programmed to Therapy On.*

Therapy Off Mode

The Therapy Off mode disables automatic therapy delivery while still allowing manual control of shock delivery. Programmable parameters may be viewed and adjusted via the programmer. Also, the subcutaneous electrogram (S-ECG) may be displayed or printed.

The device automatically defaults to Therapy Off when taken out of Shelf mode.

Note: *Manual and rescue shock therapy are available when the device is set to Therapy On or Therapy Off mode, but only after the initial Setup process is complete. Refer to Setting up the EMBLEM S-ICD Pulse Generator on page 65.*

Sensing Configuration and Gain Selection

During the Automatic Setup process, the device automatically selects an optimal sensing vector based on an analysis of cardiac signal amplitude and signal-to-noise ratio. This analysis is performed on the three available vectors:

- **Primary:** Sensing from the proximal electrode ring on the subcutaneous electrode to the active surface of the device.
- **Secondary:** Sensing from the distal sensing electrode ring on the subcutaneous electrode to the active surface of the device.
- **Alternate:** Sensing from the distal sensing electrode ring to the proximal sensing electrode ring on the subcutaneous electrode.

The sensing vector can also be selected manually. The EMBLEM S-ICD Programmer User's Manual provides additional information about sensing vector selection.

The device automatically selects an appropriate gain setting during the Automatic Setup process. The gain can also be manually selected, as further explained in the EMBLEM S-ICD Programmer User's Manual. There are two gain settings:

- **1x Gain (± 4 mV):** Selected when the signal amplitude is clipped at the 2x gain setting.
- **2x Gain (± 2 mV):** Selected when the signal amplitude is not clipped at this setting.

Sensing and Tachyarrhythmia Detection

The device is designed to prevent inappropriate therapy delivery as a result of noise sensing or multiple counting of individual cardiac cycles. This is accomplished by an automatic analysis of sensed signals, which includes event detection, certification and decision phases.

Detection Phase

During the Detection Phase, the device uses a detection threshold to identify sensed events. The detection threshold is automatically adjusted continuously using amplitudes of recently detected electrical events. In addition, detection parameters are modified to increase sensitivity when rapid rates are detected. Events detected during the Detection Phase are passed on to the Certification Phase.

Certification Phase

The Certification Phase examines the detections and classifies them as certified cardiac events or as suspect events. Certified events are used to ensure that an accurate heart rate is passed to the Decision Phase. A suspect event can be one whose pattern and/or timing indicates the signal is caused by noise, such as a muscle artifact or some other extraneous signal. Events are also marked as suspect if they appear to derive from double or triple detections of single cardiac events. The device is designed to identify and correct multiple detections of wide QRS complexes and/or erroneous detections of a T-wave.

Decision Phase

The Decision Phase examines all certified events and continuously calculates a running four R-to-R interval average (4 RR average). The 4 RR average is used throughout the analysis as an indicator of the heart rate.

Therapy Zones

The device allows the selection of rate thresholds that define a Shock Zone and an optional Conditional Shock Zone. In the Shock Zone, rate is the only criterion used to determine if a rhythm will be treated with a shock. The Conditional Shock Zone has additional discriminators used to determine if a shock is warranted to treat an arrhythmia.

The Shock Zone is programmable from 170 – 250 bpm in increments of 10 bpm. The Conditional Shock Zone must be lower than the Shock Zone, with a range of 170 - 240 bpm in increments of 10 bpm.

Note: To ensure proper detection of Vf, program the Shock Zone or Conditional Shock Zone to 200 bpm or less.

Note: The IDE Study demonstrated a significant reduction in inappropriate therapy with the activation of the Conditional Shock Zone prior to hospital discharge (see S-ICD System Clinical Investigation, page 15).

Graphically, the use of a Shock Zone and Conditional Shock Zone is shown below (Figure 7):

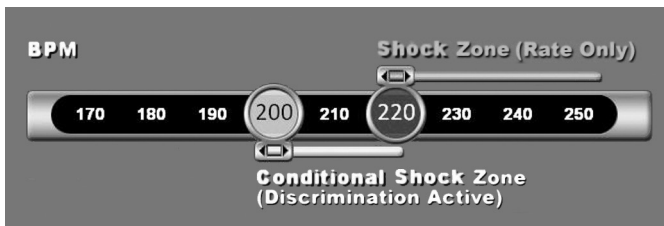


Figure 7: Shock Zone Rate Detection Diagram

The device declares a Tachycardia when the 4RR average enters either therapy zone.

Once a Tachycardia is declared, the 4RR average must become longer (in ms) than the lowest rate zone plus 40 ms for 24 cycles for the device to consider the episode to have ended. In the Shock Zone, treatable arrhythmias are determined by rate alone.

Analysis in the Conditional Shock Zone

In contrast, rate and morphology are analyzed in the Conditional Shock Zone. The Conditional Shock Zone is designed to discriminate between treatable and other high-rate events such as atrial fibrillation, sinus tachycardia and other supraventricular tachycardias.

A normal sinus rhythm template (NSR Template) is formed during device initialization. This NSR template is used during analysis in the Conditional Shock Zone to identify treatable arrhythmias. In addition to morphology comparison with the NSR template, other morphologic analysis is used to identify polymorphic rhythms. Morphology and QRS width are used to identify monomorphic arrhythmias such as ventricular tachycardia. If the Conditional Shock Zone is enabled, then an arrhythmia is found to be treatable according to the decision tree shown below (Figure 8).

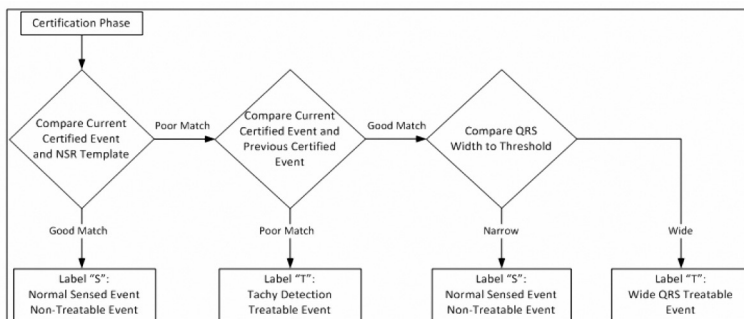


Figure 8: Decision tree for determining treatable arrhythmias in the Conditional Shock Zone

For some patients, a NSR Template may not be formed during device initialization as a result of variability in their cardiac signal at resting heart rates. For such patients, the device uses beat-to-beat morphology and QRS width analysis for arrhythmia discrimination.

Charge Confirmation

The device must charge the internal capacitors before shock delivery. Confirmation of the ongoing presence of a tachyarrhythmia requires monitoring a moving window of the 24 most recent intervals defined by certified events. Charge confirmation employs an X (treatable interval) out of Y (total intervals in the window) strategy to accomplish this. If 18 of the 24 most recent intervals are found to be treatable, the device begins to analyze rhythm persistence. Persistence analysis requires the X out of Y condition be maintained or exceeded for at least two consecutive intervals; however, this value may be increased as a result of Smart Charge, as explained below.

Capacitor charging is initiated when the following three conditions are met:

1. X of Y criterion is satisfied
2. Persistence requirement is satisfied
3. The last two certified intervals are in the treatable zone.

Therapy Delivery

Rhythm analysis continues throughout the capacitor charging process. Therapy delivery is aborted if the 4 RR average interval becomes longer (in ms) than the lowest rate zone plus 40 ms for 24 intervals. When this occurs, an untreated episode is declared and a Smart Charge extension is incremented, as explained below.

Capacitor charging continues until the capacitor has reached its target voltage, at which time reconfirmation is performed. Reconfirmation is used to ensure that the treatable rhythm did not spontaneously terminate during the charging cycle. Reconfirmation requires the last three consecutive detected intervals (regardless of whether the intervals are certified or suspect) to be faster than the lowest therapy zone. If non-treatable events are detected during or after the charging sequence, reconfirmation is automatically extended, one interval at a time, up to a maximum of 24 intervals.

Reconfirmation is always performed and shock delivery is non-committed until reconfirmation is complete. Once the criteria for reconfirmation are met, the shock is delivered.

Smart Charge

Smart Charge is a feature that automatically increases the Persistence requirement by three intervals each time an untreated episode is declared, up to a maximum of five extensions. Thus, after an untreated episode, the requirement to start capacitor charging becomes more stringent. The Smart Charge extension value can be reset to its nominal value (zero extensions) using the programmer. The Smart Charge feature cannot be disabled, though it is not used for the second and later shocks that occur during any given episode.

Redetection

A blanking period is enabled following delivery of a high-voltage shock. After delivery of the first shock, up to four additional shocks will be delivered if the episode does not terminate. Rhythm analysis for delivering shocks 2 - 5 generally follows the detection steps described above, with the following exceptions:

1. Following the first shock delivery, the X/Y criterion is modified to require 14 treatable intervals in the last 24 (14/24), rather than 18.
2. The Persistence Factor is always set to two intervals (i.e., not modified by the Smart Charge feature).

Shock Waveform and Polarity

The shock waveform is biphasic, with a fixed tilt of 50%. The shock is delivered synchronously unless a 1000 ms time out expires without an event being detected for synchronization, at which time the shock is delivered in an asynchronous manner.

The device is designed to automatically select the appropriate polarity for therapy. Both standard and reversed polarity shocks are available. If a shock fails to convert the arrhythmia and subsequent shocks are required, polarity is automatically reversed for each successive shock. The polarity of the successful shock is then retained as the starting polarity for future episodes. Polarity can also be selected during the Induction and Manual Shock process to facilitate device-based testing.

Post-Shock Bradycardia Pacing Therapy

The device provides optional post-shock, on-demand bradycardia pacing therapy. When enabled via the programmer, bradycardia pacing occurs at a non-programmable rate of 50 bpm for up to 30 seconds. The pacing output is fixed at 200 mA, and uses a 15 ms biphasic waveform.

Pacing is inhibited if the intrinsic rate is greater than 50 bpm. In addition, post-shock pacing is terminated if a tachyarrhythmia is detected or a magnet is placed over the device during the post-shock pacing period.

Manual and Rescue Shock Delivery

Upon programmer command, the device can deliver manual and rescue shocks. Manual shocks are programmable from 10 to 80 J delivered energy in 5 J steps. Rescue shocks are non-programmable, delivering the maximum output of 80 J.

Note: *A rescue shock that is commanded when the magnet is already in place will be delivered, but if the magnet is applied after the rescue shock is commanded, the shock will be aborted. Refer to the S-ICD System Magnet Use section for complete information.*

Additional Features of the S-ICD System

This section presents descriptions of several additional features available in the S-ICD System.

Auto Capacitor Reformation

The device automatically performs a full-energy (80 J) capacitor reformation when taken out of Shelf mode and every four months until the device reaches Elective Replacement (ERI). The energy output and reformation time interval are non-programmable. The Auto Capacitor Reformation interval is reset after any 80 J capacitor charge is delivered or aborted.

Internal Warning System – Beeper Control

The device has an internal warning system (beeper) that emits an audible tone to alert the patient to certain device conditions that require prompt consultation with the physician. These conditions include:

- Elective Replacement (ERI) and End of Life (EOL) indicators (see page 48)
- Electrode impedance out of range
- Prolonged charge times
- Failed Device Integrity Check
- Irregular battery depletion

This internal warning system is automatically activated at time of implant. Once triggered, the beeper sounds for 16 seconds every nine hours until the trigger condition has been resolved. If the triggering condition reoccurs, then the tones will once again alert the patient to consult the physician. The beeper can be disabled via the programmer once ERI is reached.

Caution: *Patients should be advised to contact their physician immediately whenever they hear beeping tones coming from their device.*

Note: *The beeper may be activated for demonstration purposes in the clinic by applying a magnet over the device to elicit the beeping tones.*

Arrhythmia Induction

The device facilitates testing by providing the capability to induce a ventricular tachyarrhythmia. Via the programmer, the implanted system can deliver a 200 mA output at a frequency of 50 Hz. The maximum length of stimulation is 10 seconds.

Note: *Induction requires that the device be programmed to Therapy On.*

Warning: *Always have external defibrillation equipment and medical personnel skilled in CPR available during implant and follow-up testing. If not terminated in a timely fashion, an induced ventricular tachyarrhythmia can result in the patient's death.*

System Diagnostics

The S-ICD system automatically performs a diagnostic check at scheduled intervals.

Subcutaneous Electrode Impedance

A subcutaneous electrode integrity test is performed once a week using a sub-threshold energy pulse. The Summary report indicates whether the measured impedance is in range by reporting "Ok" for values below 400 ohms. Values above 400 ohms will result in activation of the internal warning system (beeping tones).

Note: *If the device is taken out of Shelf mode, but not implanted, the internal warning system will be activated due to the weekly automatic measurements of impedance. Device beeping due to this mechanism is normal behavior.*

In addition, subcutaneous electrode impedance is measured each time a shock is delivered, and the shock impedance values are stored and displayed in the episode data and reported on the programmer screen just after the shock is delivered. Reported shock impedance values should be within 25 – 200 ohms. A reported value of greater than 200 ohms will activate the internal warning system.

Caution: *A reported shock impedance value of less than 25 ohms from a delivered shock could indicate a problem with the device. The delivered shock may have been compromised, and/or any future therapy from the device may be compromised. If a reported impedance value of less than 25 ohms is observed, correct functioning of the device should be verified.*

Note: *Measurement of electrode impedance either by the sub-threshold measurement or during shock delivery may not detect a loose setscrew due to the location of the setscrew at the electrode tip.*

Device Integrity Check

The Device Integrity Check is automatically performed daily by the implanted system, and also each time the programmer communicates with an implanted device. This test scans for any unusual conditions in the device and, if any are detected, the system provides a notification either via the pulse generator's internal warning system or on the programmer screen.

Battery Performance Monitoring System

The device automatically monitors battery status to provide notice of impending battery depletion. Two indicators are provided via messages on the programmer, each activated by declining battery voltage. ERI and EOL are also signaled by activation of the device's beeper.

- **Elective Replacement Indicator (ERI):** When the ERI is detected, the device will provide therapy for at least three months, if no more than six maximum energy charges/shocks occur. The patient should be scheduled for replacement of the device.
- **End of Life (EOL):** When the EOL indicator is detected, the device should be replaced immediately. Therapy may not be available when EOL is declared.

Storing and Analyzing Data

The device stores S-ECGs for up to 25 treated and 20 untreated tachyarrhythmia episodes. An episode is only stored if it progresses to the point where charging is initiated. The number of treated episodes, untreated episodes, and the therapy shocks delivered since the last follow-up procedure and initial implant are recorded and stored. Through wireless communication with the programmer, the stored data is retrieved for analysis and report printouts.

Note: *Episode data associated with programmer commanded rescue shocks, manual shocks, induction testing or episodes that occur while communicating with the programmer are not stored by the pulse generator. Episode data associated with induction testing commanded by the programmer using the Hold to Induce button is captured by the programmer and is available as a captured S-ECG (see the EMBLEM S-ICD Programmer User's Manual for more details).*

Note: *SVT episodes with heart rates lower than or within the Conditional Shock zone are not stored.*

Treated Episodes

Up to 128 seconds of S-ECG data is stored for each treated episode:

- **First Shock:** 44 seconds prior to capacitor charging, up to 24 seconds prior to shock delivery and up to 12 seconds of post-shock S-ECG.
- **Subsequent Shocks:** A minimum of 6 seconds of pre-shock and up to 6 seconds post-shock S-ECG.

Untreated Episodes

For untreated episodes, 44 seconds of pre-episode and up to 84 seconds of episode S-ECG are stored. A return to normal sinus rhythm during an untreated episode halts S-ECG storage.




Captured S-ECG

The S-ECG can be captured in real time on rhythm strips when the device is actively linked via wireless telemetry to the programmer. Up to fifteen 12-second recordings of S-ECG can be stored.

S-ECG Rhythm Strip Markers

The system provides S-ECG annotations (*Table 13*) to identify specific events during a recorded episode. Sample annotations are shown for the programmer display (*Figure 9*) and the printed report (*Figure 10*).

Table 13: S-ECG Markers on Programmer Display Screens and Printed Reports

Description	Marker
Charging ^a	C
Sensed Beat	S
Noisy Beat	N
Paced Beat	P
Tachy Detection	T
Discard Beat	.
Return to NSR ^a	
Shock	
Episode data compressed or not available	

^a Marker present on printed report but not on programmer display screen.

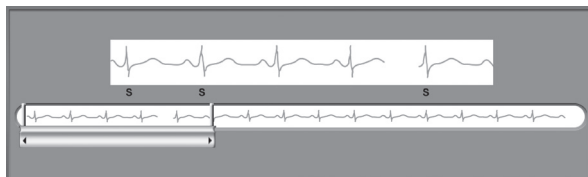


Figure 9: *Programmer display markers*

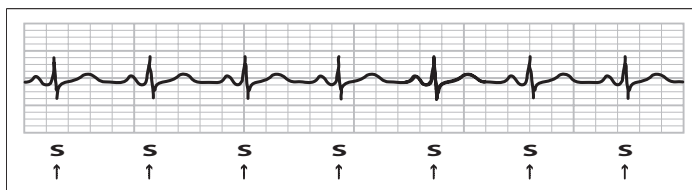


Figure 10: *Printed Report Markers*

Patient Data

The device can store the following patient data, which can be retrieved and updated through the programmer:

- Patient's name
- Physician's name and contact information
- Device and subcutaneous electrode identification information (model and serial numbers) and implant date
- Patient Notes (displayed upon connection to the device)

S-ICD System Magnet Use

The Boston Scientific magnet Model 6860 (the magnet) is a non-sterile accessory that may be used to temporarily inhibit the delivery of therapy from the device if necessary. The Cameron Health magnet Model 4520 may be used interchangeably with the Boston Scientific magnet for this purpose.

Note: *When long duration therapy suspension is desired, it is recommended to modify pulse generator behavior with the programmer rather than the magnet whenever possible.*

To suspend therapy using a magnet:

1. APPLY the magnet over the device header or over the lower edge of the device as illustrated in Figure 11.
2. LISTEN for beeping tones (use a stethoscope if necessary). Therapy is not suspended until beeping tones are heard. If no beeping is heard, try other positions within the target zones illustrated in Figure 12 until beeping tones are heard. Maintain the magnet in each tested position for one second (it takes approximately one second for the pulse generator to respond to the magnet).
3. HOLD the magnet in place to keep therapy suspended. Beeping will continue for 60 seconds while the magnet is held in place. After 60 seconds, beeping stops, but therapy continues to be inhibited unless the magnet has been moved.

Note: *If it is necessary to confirm therapy is still being inhibited after beeping has stopped, remove and replace the magnet to reactivate the beeping tones. This step can be repeated as necessary.*

4. REMOVE the magnet to resume normal pulse generator operation.

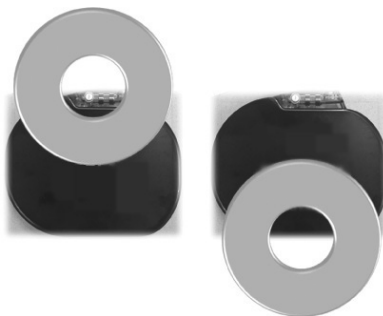


Figure 11: Starting position of the magnet for suspension of therapy

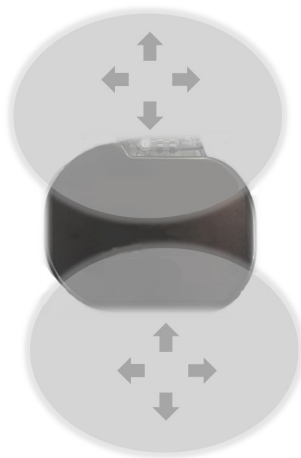


Figure 12: Grey shading indicates the zone within which magnet placement is most likely to suspend therapy, as signaled by beeping tones. Sweep the magnet vertically and horizontally across the target zone as indicated by the arrows.

Magnet use for patients with deep implant placement

Consider the following when using the magnet on patients with deep implant placement:

- If the exact location of the pulse generator is not evident, the magnet may need to be tested across a broader region of the body surrounding the anticipated pulse generator location. Unless beeping tones are heard, therapy has not been suspended.
- Beeping from a device with a deep implant location may be difficult to hear. Use a stethoscope if necessary. Correct magnet placement can only be confirmed by detection of the beeping tones.
- Multiple magnets may be used in a stacked configuration to increase the likelihood of eliciting the beeping and associated inhibition of therapy.
- If beeping tones cannot be detected, it may be necessary to use the programmer to suspend therapy in these patients.

Warning: *In patients with a deep implant placement (greater distance between the magnet and the pulse generator) magnet application may fail to elicit the magnet response. In this case the magnet cannot be used to inhibit therapy.*

Magnet Response and Pulse Generator Mode

The effect of the magnet on the pulse generator varies depending on the Mode the pulse generator is programmed to (Shelf, Therapy On, or Therapy Off) as shown in Table 14.

Table 14: *Magnet Response*

Pulse Generator Mode	Magnet Response
Shelf Mode	<ul style="list-style-type: none"> • A single beep sounds when the magnet is detected
Therapy On	<ul style="list-style-type: none"> • Arrhythmia detection and therapy response are suspended until the magnet is removed • The beeper sounds with each detected QRS complex for 60 seconds or until the magnet is removed, whichever occurs first • Programmer commanded rescue shocks and manual shocks are aborted if the magnet is applied after the shock is commanded^a • Post-shock pacing is terminated • Arrhythmia induction testing is prohibited
Therapy Off	<ul style="list-style-type: none"> • The beeper sounds with each detected QRS complex for 60 seconds or until the magnet is removed, whichever occurs first • Programmer commanded rescue shocks and manual shocks are aborted if the magnet is applied after the shock is commanded^a • Post-shock pacing is terminated

^a Programmer commanded rescue shocks and manual shocks are delivered if they are commanded with the magnet already in place

Note: *If the magnet is applied during an episode, the episode will not be stored in the device memory.*

Note: *Magnet application does not affect wireless communication between the device and the programmer.*

Bidirectional Torque Wrench

A torque wrench (model 6628) is included in the sterile tray with the pulse generator, and is designed for tightening and loosening #2-56 setscrews, captured setscrews, and setscrews on this and other Boston Scientific pulse generators and lead accessories that have setscrews that spin freely when fully retracted (these setscrews typically have white seal plugs).

This torque wrench is bidirectional, and is preset to apply adequate torque to the setscrew and will ratchet when the setscrew is secure. The ratchet release mechanism prevents overtightening that could result in device damage. To facilitate the loosening of tight extended setscrews, this wrench applies more torque in the counterclockwise direction than in the clockwise direction.

Note: *As an additional safeguard, the tip of the torque wrench is designed to break off if used to overtighten beyond preset torque levels. If this occurs, the broken tip must be extracted from the setscrew using forceps.*

This torque wrench may also be used for loosening setscrews on other Boston Scientific pulse generators and lead accessories that have setscrews that tighten against a stop when fully retracted (these setscrews typically have clear seal plugs). However, when retracting these setscrews, stop turning the torque wrench when the setscrew has come in contact with the stop. The additional counterclockwise torque of this wrench may cause these setscrews to become stuck if tightened against the stop.

Using the EMBLEM S-ICD Pulse Generator

Items Included in Package

The device has been sterilized with ethylene oxide gas and is packaged in a sterile container that is suitable for use in the operating field. Store in a clean, dry area. Each package contains the following:

- One EMBLEM S-ICD pulse generator Model A209
- One bidirectional torque wrench
- One EMBLEM S-ICD pulse generator Model A209 user's manual

Note: *Accessories (e.g. wrenches) are intended for one-time use only. They should not be resterilized or reused.*

Implanting the S-ICD System

This section presents the information necessary for implanting and testing the S-ICD System, including:

- Implanting the EMBLEM S-ICD pulse generator (the “device”)
- Implanting the EMBLEM S-ICD subcutaneous electrode (the “electrode”) using the EMBLEM S-ICD subcutaneous electrode insertion tool (the “EIT”)
- Setting up and testing the device using the EMBLEM S-ICD programmer (the “programmer”).

Warning: *All Boston Scientific S-ICD implantable components are designed for use with the Boston Scientific or Cameron Health S-ICD System only. Connection of any S-ICD System components to a non-compatible component will result in failure to deliver life-saving defibrillation therapy.*

The S-ICD System is designed to be positioned using anatomical landmarks. However, it is recommended to review a pre-implant chest x-ray in order to confirm that a patient does not have notably atypical anatomy (e.g. dextrocardia). Additionally, it is not recommended to deviate from the implant instructions to accommodate for physical body size or habitus, unless a pre-implant chest x-ray has been reviewed.

The device and subcutaneous electrode are typically implanted subcutaneously in the left thoracic region (*Figure 13*). The EIT is used to create the subcutaneous tunnels in which the electrode is inserted.

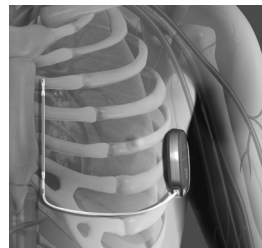


Figure 13: *Placement of the S-ICD System*

Check Equipment

It is recommended that instrumentation for cardiac monitoring and defibrillation be available during the implant procedure. This includes the S-ICD System Programmer with its related accessories and the software application. Before beginning the implantation procedure, become completely familiar with the operation of all the equipment and the information in the respective user’s manuals. Verify the operational status of all equipment that may be used during the procedure. In case of accidental damage or contamination, the following should be available:

- Sterile duplicates of all implantable items
- Wand in a sterile barrier
- Torque and non-torque wrenches

During the implantation procedure, always have a standard transthoracic defibrillator with external pads or paddles available for use during defibrillation threshold testing.

Interrogate and Check the Pulse Generator

To maintain sterility, test the pulse generator as described below before opening the sterile blister tray. The pulse generator should be at room temperature to ensure accurately measured parameters.

1. Place the wand directly over the pulse generator.
2. From the programmer startup screen, select the Scan for Devices button.
3. Identify the pulse generator being implanted from the Device List screen and verify that the status of the pulse generator is reported as 'Not Implanted'. This indicates the pulse generator is in Shelf Mode. If otherwise, contact Boston Scientific using the information on the back cover.
4. From the Device List screen, select the pulse generator being implanted to initiate a communication session.
5. Upon connection with the pulse generator, the programmer will display an alert if the pulse generator battery status is below the appropriate level for a device at implant. If a battery alert appears, contact Boston Scientific using the information on the back cover.

Creating the Device Pocket

The device is implanted in the left lateral thoracic region. To create the device pocket, make an incision such that the device can be placed in the vicinity of the left 5th and 6th intercostal spaces and near the mid-axillary line (*Figure 14*). This can be accomplished by making an incision along the inframammary crease.



Figure 14: *Creating the device pocket*

Implanting the EMBLEM S-ICD Subcutaneous Electrode

The procedure described below is one of several surgical approaches that can be used to appropriately implant and position the electrode. Regardless of the surgical approach, the defibrillation coil must be positioned parallel to the sternum, in close proximity to, or in contact with the deep fascia, approximately 2 cm from the sternal midline (*Figure 13*). In addition, good tissue contact with the electrode and pulse generator is important to optimize sensing and therapy delivery. Use standard surgical techniques to obtain good tissue contact. For example, keep the tissue moist and flushed with sterile saline, express any residual air out through the incisions prior to closing and, when closing the skin, take care not to introduce air into the subcutaneous tissue.

1. Make a small, 2 cm horizontal incision at the xiphoid process (xiphoid incision).

Note: *If desired, in order to facilitate attachment of the suture sleeve to the fascia following electrode placement, two suture ties to the fascia can be made at the xiphoid incision prior to continuing.*

2. Insert the distal tip of the EIT at the xiphoid incision and tunnel laterally until the distal tip emerges at the device pocket.

Note: *The EIT is malleable and can be curved to match the patient's anatomical profile.*

Caution: *Use only the electrode insertion tool to create the subcutaneous tunnel when implanting and positioning the subcutaneous electrode.*

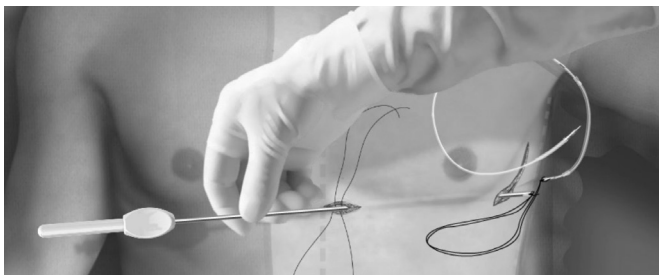


Figure 15: *Connecting the distal end of the subcutaneous electrode to the EIT*

3. Using conventional suture material, tie the anchoring hole of the subcutaneous electrode to the EIT creating a long 15-16 cm loop (*Figure 15*).

-
4. With the subcutaneous electrode attached, carefully pull the EIT back through the tunnel to the xiphoid incision until the proximal sensing electrode emerges.
 5. Place a suture sleeve over the subcutaneous electrode shaft 1 cm below the proximal sensing electrode. Using the preformed grooves, bind the suture sleeve to the subcutaneous electrode shaft using 2-0 silk or similar non-absorbable suture material, making sure not to cover the proximal sensing electrode. Check the suture sleeve after anchoring to assure stability by grasping the suture sleeve with fingers and trying to move the subcutaneous electrode in either direction.
Note: *Do not secure the suture sleeve and subcutaneous electrode to the fascia until electrode placement is complete*
 6. Make a second incision approximately 14 cm superior to the xiphoid incision (superior incision). If desired, place the exposed subcutaneous electrode on the skin to make this measurement. The distance between the superior and xiphoid incisions must accommodate the portion of the subcutaneous electrode from the distal sensing electrode to the proximal sensing electrode. Pre-place one or two fascial sutures in superior incision. Use a non-absorbable suture material of appropriate size for long term retention. Apply gentle traction to ensure adequate tissue fixation. Retain the needle on the suture for later use in passing through the electrode anchoring hole.
 7. Insert the distal tip of the EIT into the xiphoid incision and tunnel subcutaneously towards the superior incision, staying as close to the deep fascia as possible (*Figure 16*).

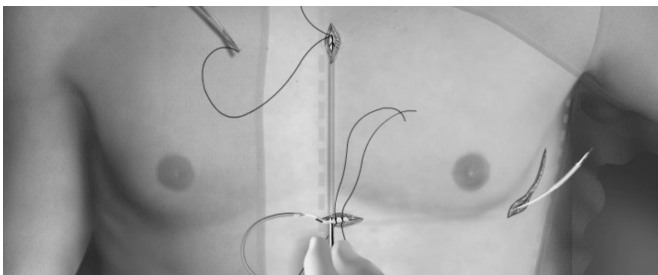


Figure 16: Tunneling to Superior Incision

8. Once the distal tip of the EIT emerges from the superior incision, disconnect and retain the suture loop from the distal tip of the EIT. Secure the ends of the suture with a surgical clamp. Remove the EIT.

-
9. Using the secured suture at the superior incision, carefully pull the suture and subcutaneous electrode through the tunnel until the anchoring hole emerges. The subcutaneous electrode should be parallel to the sternal midline with the defibrillation coil in close proximity to the deep fascia.
 10. Cut and discard the suture material.
 11. At the xiphoid incision, secure the suture sleeve with the subcutaneous electrode to the fascia using 2-0 silk or similar non-absorbable suture material.

Warning: Use appropriate anchoring techniques as described in the implant procedure to prevent S-ICD System dislodgement and/or migration. Dislodgement and/or migration of the S-ICD System may result in an inappropriate shock or failure to deliver therapy to the patient.

Caution: Do not suture directly over the subcutaneous electrode body, as this may cause structural damage. Use the suture sleeve to prevent subcutaneous electrode movement.

Caution: Suture only those areas indicated in the implant instructions.

Note: Ensure that the suture is securely fastened to fascia by gently tugging on the suture prior to tying to the suture sleeve and subcutaneous electrode.

12. At the superior incision, secure the anchoring hole to the fascia using the pre-placed sutures from step 6 (Figure 17).

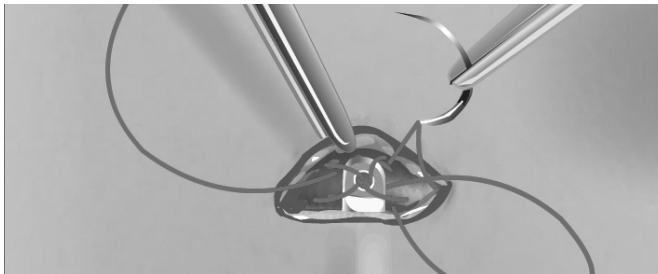


Figure 17: Anchoring the distal tip of the subcutaneous electrode

Note: Ensure that the suture is securely fastened to fascia by gently tugging on the suture prior to tying to the subcutaneous electrode anchoring hole.

13. Gently tug the subcutaneous electrode at the superior incision to ensure the anchoring hole is secured to the fascia.
14. To dispose of the EIT, return the used product to the original package, then dispose in a biohazard container.

-
15. To ensure good tissue contact with the implanted subcutaneous electrode, flush the xiphoid and superior incisions with sterile saline solution and apply firm pressure along the electrode to express any residual air out through the incisions prior to closing.

Connecting the Subcutaneous Electrode to the Device

When connecting the subcutaneous electrode to the device, use only the tools provided in the device tray. Failure to use the supplied tools may result in damage to the setscrew. Retain the tools until all testing procedures are complete and the device is implanted.

Caution: *Verify the device is in Shelf mode or Therapy Off to prevent the delivery of unwanted shocks to the patient or the person handling the device during the implant procedure.*

Note: *Avoid allowing blood or other body fluids to enter the connector port in the device header. If blood or other body fluids inadvertently enter the connector port, flush with sterile water.*

Note: *Do not implant the device if the setscrew seal plug appears to be damaged.*

1. If applicable, remove and discard the tip protection before using the torque wrench.
2. Gently insert the torque wrench blade into the setscrew by passing it through the preslit, center depression of the seal plug at a 90° angle (*Figure 18*). This will open up the seal plug, relieving any potential pressure build-up from the connector port by providing a pathway to release trapped fluid or air.

Note: *Failure to properly insert the torque wrench in the preslit depression of the seal plug may result in damage to the plug and its sealing properties.*

Caution: *Do not insert the subcutaneous electrode into the pulse generator connector port without taking the following precautions to ensure proper insertion:*

- *Insert the torque wrench into the preslit depression of the seal plug before inserting the subcutaneous electrode connector into the port, to release any trapped fluid or air.*
- *Visually verify that the setscrew is sufficiently retracted to allow insertion. Use the torque wrench to loosen the setscrew if necessary.*
- *Fully insert the subcutaneous electrode connector into the port and then tighten the setscrew onto the connector.*

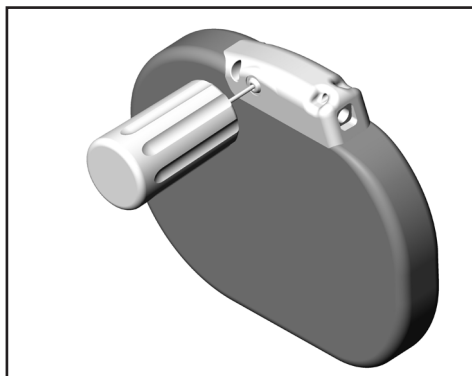


Figure 18: *Inserting the torque wrench*

3. With the torque wrench in place, fully insert the subcutaneous electrode terminal into the electrode port. Grip the subcutaneous electrode close to the connector and insert it straight into the connector port. The electrode is fully inserted when the tip of the connector is visible beyond the connector block when viewed from the top. Refer to Figure 19 for illustrations of the header connector block with no electrode inserted (top panel) and with the electrode fully inserted (bottom panel). Place pressure on the subcutaneous electrode to maintain its position and ensure that it remains fully inserted in the connector port.

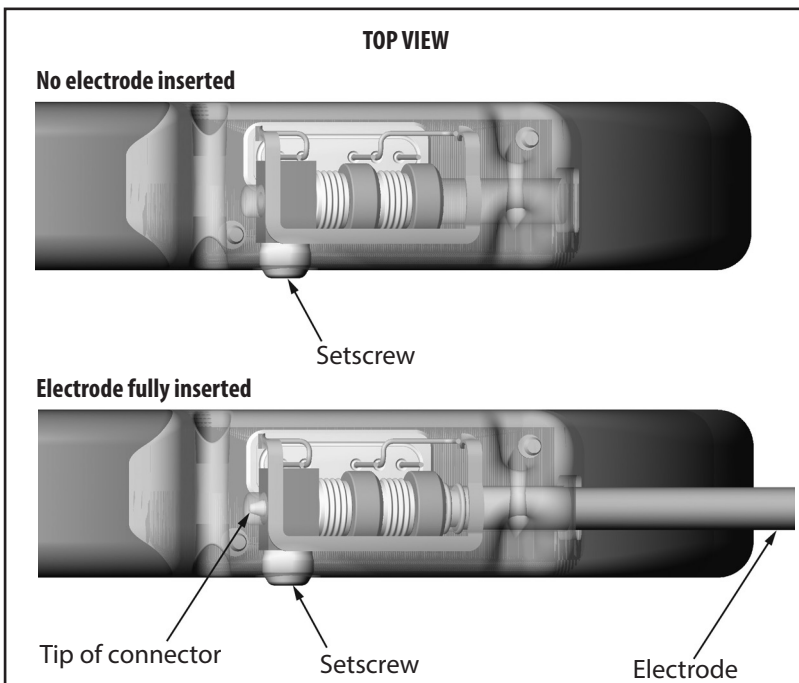


Figure 19: Position of the subcutaneous electrode connector

Warning: Use caution handling the subcutaneous electrode connector. Do not directly contact the connector with any surgical instruments such as forceps, hemostats, or clamps. This could damage the connector. A damaged connector may result in compromised sealing integrity, possibly leading to compromised sensing, loss of therapy, or inappropriate therapy.

Caution: Do not bend the subcutaneous electrode near the subcutaneous electrode-header interface. Improper insertion can cause insulation or connector damage.

Note: If necessary, lubricate the connector sparingly with sterile water to make insertion easier.

-
4. Apply gentle downward pressure on the torque wrench until the blade is fully engaged within the setscrew cavity, taking care to avoid damage to the seal plug. Tighten the setscrew by slowly turning the torque wrench clockwise, until it ratchets once. The torque wrench is preset to apply the proper amount of force to the captive setscrew; additional rotation and force is unnecessary.
 5. Remove the torque wrench.
 6. Apply gentle traction to the subcutaneous electrode to ensure a secure connection.
 7. If the subcutaneous electrode terminal is not secure, attempt to reseat the setscrew. Reinsert the torque wrench as described above, and loosen the setscrew by slowly turning the wrench counterclockwise, until the subcutaneous electrode is loose. Then repeat the sequence above.
 8. Insert the device into the subcutaneous pocket, with any excess subcutaneous electrode placed underneath the device.
 9. Anchor the device to the fascia to prevent possible migration using conventional 0-silk or similar non-absorbable suture material. Two suture holes are provided in the header for this purpose (*Figure 20*).
 10. Flush the pulse generator pocket with sterile saline solution and ensure there is good contact between the pulse generator and the surrounding tissue of the pocket prior to closing the first layer of tissue and prior to performing Automatic Setup of the device.

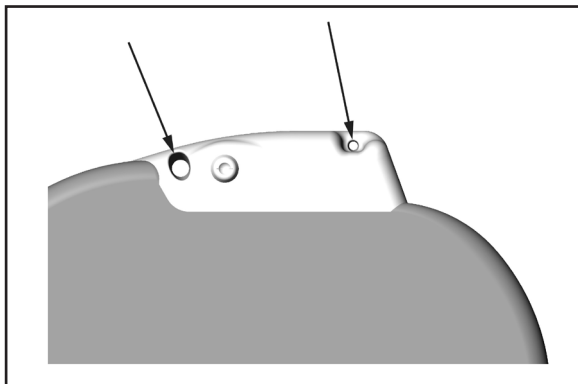


Figure 20: Header suture holes for anchoring the device

11. Perform Automatic Setup as described on page 65 of this manual.

-
12. After performing Automatic Setup, and with the device mode still set to Therapy Off, palpate the subcutaneous electrode while monitoring the real-time S-ECG on the programmer screen for evidence of inappropriate sensing. If inappropriate sensing is observed, do not proceed until it is resolved. Contact Boston Scientific for assistance if necessary. Once the baseline is stable and appropriate sensing is observed, set the device mode to Therapy On and conduct defibrillation testing if desired. (See page 66 of this manual for Defibrillation testing instructions.)
 13. After device setup and defibrillation testing, close all incisions. Use standard surgical techniques to achieve good tissue contact with both the subcutaneous electrode and pulse generator, for example avoiding any air entrapment in the subcutaneous tissue.



Figure 21: *System placement after closure of all incisions*

Setting up the EMBLEM S-ICD Pulse Generator using the Model 3200 S-ICD Programmer

A brief setup process must be completed before the device can deliver manual or automatic therapy. Additional details can be found in the EMBLEM S-ICD Model 3200 Programmer User's Manual. This process can be performed automatically or manually during the implant procedure, although Automatic Setup is recommended. During setup, the system automatically:

- Confirms entry of the subcutaneous electrode model and serial numbers.
- Measures the shock electrode impedance.
- Optimizes the sense electrode configuration.
- Optimizes the gain selection.
- Acquires a reference NSR template.

To initiate the Automatic Setup process:

1. After using the programmer to scan for devices, choose the device being implanted from the Device List screen.
2. The programmer will connect to the chosen pulse generator and the Device Identification screen will appear. Choosing the Continue button from this screen removes the pulse generator from Shelf Mode and causes the Automatic Setup screen to appear.
3. Select the Automatic Setup button to initiate Automatic Setup.
4. Follow the on-screen instructions to complete the Automatic Setup sequence.

If the patient's heart rate is greater than 130 bpm, you will be instructed to complete the Manual Setup process instead. To initiate the Manual Setup process:

1. From the Main Menu screen, select the Utilities button.
2. From the Utilities screen, select the Manual Setup button.

You will be guided through a manual impedance test, selection of sensing vector, selection of gain setting, and acquisition of a reference S-ECG.

Defibrillation Testing

Once the device is implanted and programmed to Therapy On, defibrillation testing may be conducted. A 15J safety margin is recommended for defibrillation testing.

Note: *Defibrillation testing is recommended at implant to confirm the ability of the S-ICD System to sense and convert VF.*

Warning: *Always have external defibrillation equipment and medical personnel skilled in CPR available during implant and follow-up testing. If not terminated in a timely fashion, an induced ventricular tachyarrhythmia can result in the patient's death.*

To induce VF and test the S-ICD System using the Model 3200 S-ICD programmer:

1. Select the Main Menu icon (arrow within a circle) in the Navigation bar, in the top right corner of the screen.
2. From the Main Menu screen, select the Patient Test button to setup the induction test.
3. Follow the on-screen instructions to set shock energy and polarity and to induce an arrhythmia.

Note: *Ensure that noise markers ("N") are not present on the S-ECG prior to induction. The presence of noise markers may delay detection and therapy delivery.*

4. At any time prior to therapy delivery, the programmed energy may be aborted by selecting the red Abort button.

-
5. Select the Exit button to exit the induction process and return to the Main Menu screen.

The following functions occur during the test:

- The S-ICD System induces ventricular fibrillation using 200 mA alternating current (AC) at 50 Hz. Induction continues until the Hold To Induce button is released (up to a maximum of 10 seconds per attempt).
Note: *If necessary, the induction can be terminated by disconnecting the wand from the programmer.*
- Arrhythmia detection and the Live S-ECG are suspended during AC induction. Once the Hold to Induce button is released, the programmer displays the patient's rhythm.
- Upon detection and confirmation of an induced arrhythmia, the S-ICD System automatically delivers a shock at the programmed energy output and polarity.

Note: *Whenever the programmer is in active communication with an S-ICD pulse generator, charging of the pulse generator in preparation for delivering a shock (whether commanded or in response to a detected arrhythmia) is indicated by an audible notification. The notification continues until the shock is delivered or aborted.*

- If the shock fails to convert the arrhythmia, re-detection occurs and subsequent shocks are delivered at the pulse generator's maximum energy output (80 J).

Note: *The EMBLEM S-ICD pulse generator can deliver a maximum of five shocks per episode. At any time, an 80 J rescue shock can be delivered by pressing the Rescue Shock button.*

Note: *Following the release of the Hold To Induce button, evaluate the sensing markers during the induced rhythm. The S-ICD System uses a lengthened rhythm detection period. Consistent tachy "T" markers indicate that tachyarrhythmia detection is occurring, and that capacitor charging is imminent. If a high degree of amplitude variation is noted during the arrhythmia, a slight delay may be expected prior to capacitor charging or shock delivery.*

If appropriate sensing or VF conversion cannot be demonstrated, consider changing the selected sense configuration or relocating the subcutaneous electrode or device and then retest. VF conversion testing can be conducted in either polarity.

Complete and Return the Implantation Form

Within ten days of implantation, complete the Warranty Validation and Lead Registration form and return the original to Boston Scientific along with copies of the Summary Report, Captured S-ECG Report, and Episode Report(s) printed from the programmer. This information enables Boston Scientific to register each implanted pulse generator and subcutaneous electrode, and provide clinical data on the performance of the implanted system. Keep a copy of the Warranty Validation and Lead Registration form and programmer printouts for the patient's file.

Patient Counseling Information

The following topics should be discussed with the patient prior to discharge.

- External defibrillation—the patient should contact their physician to have their pulse generator system evaluated if they receive external defibrillation
- Beeping tones—the patient should contact their physician immediately if they hear tones coming from their pulse generator
- Signs and symptoms of infection
- Symptoms that should be reported (e.g., lightheadedness, palpitations, unexpected shocks)
- Protected environments—the patient should seek medical guidance before entering areas protected by a warning notice that prevents entry by patients who have a pulse generator
- Avoiding potential sources of EMI in home, work, and medical environments
- Persons administering CPR—the presence of voltage (tingling) on the patient's body surface may be experienced when the pulse generator delivers a shock
- Reliability of their pulse generator ("Product Reliability" on page 72)
- Activity restrictions (if applicable)
- Frequency of follow-up
- Travel or relocation—Follow-up arrangements should be made in advance if the patient is leaving the country of implant
- Patient ID card—the patient should be advised to carry their patient ID card at all times (a temporary patient ID card is provided with the device, and a permanent ID card will be sent to the patient 4 to 6 weeks after the implant form is received by Boston Scientific)

Patient Guide

A copy of the Patient Guide is available for the patient, patient's relatives, and other interested people.

It is recommended that you discuss the information in the Patient Guide with concerned individuals both before and after implantation so they are fully familiar with pulse generator operation.

For additional copies, contact Boston Scientific using the information on the back cover.

Post Implant Follow-Up Procedures

It is recommended that device functions be evaluated with periodic follow-up testing by trained personnel to enable review of device performance and associated patient health status throughout the life of the device.

Warning: *Always have external defibrillation equipment and medical personnel skilled in CPR available during implant and follow-up testing. If not terminated in a timely fashion, an induced ventricular tachyarrhythmia can result in the patient's death.*

Immediately following the implant procedure, it is recommended that the following procedures be performed:

1. Interrogate the pulse generator and review the Device Status screen (refer to the EMBLEM S-ICD Programmer User's Manual for additional information).
2. Perform sensing optimization (refer to Setting up the EMBLEM S-ICD Pulse Generator, page 65, for instructions on performing Automatic Setup including sensing optimization)
3. Follow the on-screen instructions to capture a reference S-ECG
4. Print the Summary Report, Captured S-ECG Report, and Episode Report(s) to retain in the patient's files for future reference.
5. End session

During a follow-up procedure, it is recommended that the location of the subcutaneous electrode be periodically verified by palpation and/or X-ray. When device communication with the programmer is established, the programmer automatically notifies the physician of any unusual conditions. Refer to the EMBLEM S-ICD Programmer User's Manual for more information.

Patient management and follow-up are at the discretion of the patient's physician, but are recommended one month after implant and at least every 3 months to monitor the condition of the patient and evaluate device function. Office visits may be supplemented by remote monitoring where available.

Note: *Because the duration of the device replacement timer is three months (starting when ERI is reached), three month follow-up frequency is particularly important to ensure timely replacement of the device if necessary.*

Caution: *Successful VF or VT conversion during arrhythmia conversion testing is no assurance that conversion will occur post-operatively. Be aware that changes in the patient's condition, drug regimen, and other factors may change the DFT, which may result in nonconversion of the arrhythmia post-operatively. Verify with a conversion test that the patient's tachyarrhythmias can be detected and terminated by the pulse generator system if the patient's status has changed or parameters have been reprogrammed.*

Explantation

Note: Return all explanted pulse generators and subcutaneous electrodes to Boston Scientific. Examination of explanted pulse generators and subcutaneous electrodes can provide information for continued improvement in system reliability and warranty considerations.

Warning: Do not reuse, reprocess, or resterilize. Reuse, reprocessing, or resterilization may compromise the structural integrity of the device and/or lead to device failure which, in turn, may result in patient injury, illness, or death. Reuse, reprocessing, or resterilization may also create a risk of contamination of the device and/or cause patient infection or cross-infection, including, but not limited to, the transmission of infectious disease(s) from one patient to another. Contamination of the device may lead to injury, illness, or death of the patient.

Contact Boston Scientific:

- When a product is removed from service.
- In the event of patient death (regardless of cause), along with an autopsy report, if performed.
- Due to other observations or complications.

Note: Disposal of explanted pulse generators and/or subcutaneous electrodes is subject to applicable laws and regulations. For a Returned Product Kit, contact Boston Scientific using the information on the back cover.

Caution: Be sure that the pulse generator is removed before cremation. Cremation and incineration temperatures might cause the pulse generator to explode.

Caution: Before explanting, cleaning, or shipping the device, complete the following actions to prevent unwanted shocks, overwriting of important therapy history data, and audible tones:

- Program the pulse generator to Therapy Off mode
- If ERI or EOL has been reached, disable the beeper.

Clean and disinfect the device using standard biohazard handling techniques.

Consider the following items when explanting and returning the pulse generator and/or subcutaneous electrode:

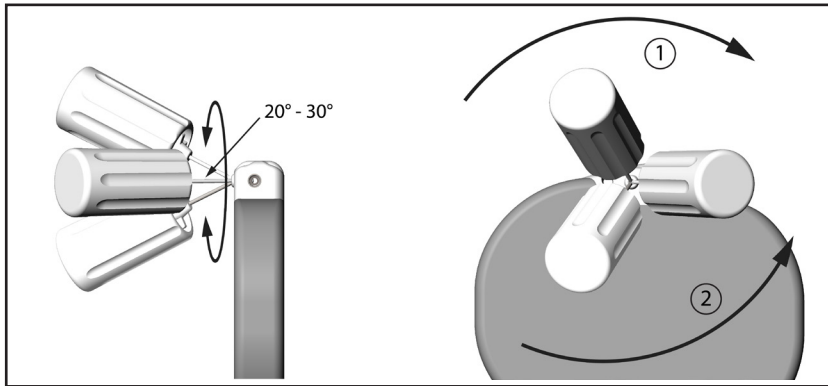
- Interrogate the pulse generator and print all reports.
- Deactivate the pulse generator before explantation.
- Disconnect the subcutaneous electrode from the pulse generator.
- If subcutaneous electrode is explanted, attempt to remove it intact, and return it regardless of condition. Do not remove the subcutaneous electrode with hemostats or any other clamping tool that may damage it. Resort to tools only if manual manipulation cannot free the subcutaneous electrode.
- Wash, but do not submerge, the pulse generator and subcutaneous electrode to remove body fluids and debris using a disinfectant solution. Do not allow fluids to enter the pulse generator's connector port.

- Use a Boston Scientific Returned Product Kit to properly package the pulse generator and/or subcutaneous electrode, and send it to Boston Scientific.

Loosening Stuck Setscrews

Follow these steps to loosen stuck setscrews:

1. From a perpendicular position, tilt the torque wrench to the side 20° to 30° from the vertical center axis of the setscrew (*Figure 22*).
2. Rotate the wrench clockwise (for retracted setscrew) or counterclockwise (for extended setscrew) around the axis three times, such that the handle of the wrench orbits the centerline of the screw (*Figure 20*). The torque wrench handle should not turn or twist during this rotation.



[1] Clockwise rotation to free setscrews stuck in the retracted position [2] Counterclockwise rotation to free setscrews stuck in the extended position

Figure 22: Rotating the torque wrench to loosen a stuck setscrew

3. As needed, you may attempt this up to four times with slightly more angle each time. If you cannot fully loosen the setscrew, use the #2 torque wrench from Wrench Kit Model 6501.
4. Once the setscrew has been freed, it may be extended or retracted as appropriate.
5. Discard the torque wrench upon completion of this procedure.

Communication Compliance

Federal Communications Commission (FCC) Compliance

This transmitter is authorized by rule under the Medical Device Radiocommunication Service (in part 95 of the FCC Rules) and must not cause harmful interference to stations operating in the 400.150 – 406.000 MHz band in the Meteorological Aids (i.e., transmitters and receivers used to communicate weather data), the Meteorological Satellite, or the Earth Exploration Satellite Services and must accept interference that may be caused by such stations, including interference that may cause undesired operation. This transmitter shall be used only in accordance with the FCC Rules governing the Medical Device Radiocommunication Service. Analog and digital voice communications are prohibited. Although this transmitter has been approved by the Federal Communications Commission, there is no guarantee that it will not receive interference or that any particular transmission from this transmitter will be free from interference.

This transmitter operates in the 402–405 MHz band using FSK modulation with radiated power conforming to the applicable 25 μ W limit. The purpose of the transmitter is to communicate with the S-ICD System programmer to transfer data and to receive and respond to programming commands.

Caution: *Changes or modifications not expressly approved by Boston Scientific could void the user's authority to operate the equipment.*

FCC ID ESCCRMA20914

Additional Information

Product Reliability

It is Boston Scientific's intent to provide implantable devices of high quality and reliability. However, these devices may exhibit malfunctions that may result in lost or compromised ability to deliver therapy. These malfunctions may include the following:

- Premature battery depletion
- Sensing or pacing issues
- Inability to shock
- Error codes
- Loss of telemetry

Refer to Boston Scientific's CRM Product Performance Report on www.bostonscientific.com for more information about device performance, including the types and rates of malfunctions that these devices have experienced historically. While historical data may not be predictive of future device performance, such data can provide important context for understanding the overall reliability of these types of products.

Sometimes device malfunctions result in the issuance of product advisories. Boston Scientific determines the need to issue product advisories based on the estimated malfunction rate and the clinical implication of the malfunction. When Boston Scientific communicates product advisory information, the decision whether to replace a device should take into account the risks of the malfunction, the risks of the replacement procedure, and the performance to date of the replacement device.

Pulse Generator Longevity

Based on simulated studies, it is anticipated that these pulse generators have average longevity to EOL as shown below. At the time of manufacture, the device has the capacity for over 100 full energy shocks. The average projected longevity, which accounts for the energy used during manufacture and storage, assumes the following conditions:

- 2 maximum energy charges at implant and 6 maximum energy shocks in the final 3-month period between ERI and EOL
- The pulse generator spends 6 months in Shelf mode during shipping and storage
- Telemetry use for 1 hour at implant and 30 minutes annually for in-clinic follow-up checks
- Standard use of the LATITUDE Communicator as follows: Weekly Device Check, monthly Full Interrogations (scheduled remote follow-ups, and quarterly patient-initiated interrogations)
- With stored Episode Report Onset EGM

Table 15: Device longevity

Annual Full Energy Charges	Average Projected Longevity (years)
3 (Normal Use ^a)	7.3
4	6.7
5	6.3

^a The median number of annual full energy charges seen in clinical testing of the first generation S-ICD system was 3.3.

Note: *The energy consumption in the longevity table is based upon theoretical electrical principles and verified via bench testing only.*

Full energy charges result from capacitor reformations, non-sustained episodes and delivered shocks.

Caution: *Battery depletion will eventually cause the S-ICD Pulse Generator to stop functioning. Defibrillation and excessive numbers of charging cycles shorten the battery longevity.*

Longevity is also affected in the following circumstances:

- A decrease in charging frequency may increase longevity
- An additional maximum energy shock reduces longevity by approximately 29 days

-
- One hour of additional telemetry reduces longevity by approximately 14 days
 - Five patient-initiated LATITUDE Communicator interrogations per week for a year reduces longevity by approximately 11 days
 - An additional 6 months in Shelf mode prior to implant will reduce longevity by 103 days

Device longevity may also be affected by tolerances of electronic components, variations in programmed parameters, and variations in usage as a result of patient condition.

Refer to the Device Status screen on the programmer and printed reports for an estimate of remaining battery capacity specific to the implanted device.

Specifications

Specifications provided at $37^{\circ}\text{C} \pm 3^{\circ}\text{C}$, and assume a 75 Ohm ($\pm 1\%$) load unless noted otherwise.

X-ray Identifier

The pulse generator has an identifier that is visible on x-ray film or under fluoroscopy. This identifier provides noninvasive confirmation of the manufacturer and consists of the following:

- The letters, BSC, to identify Boston Scientific as the manufacturer
- The number, 507, to identify the Model 2877 S-ICD programmer software application needed to communicate with the pulse generator.

The x-ray identifier is located in the pulse generator case, just below the header (*Figure 23*), and is read vertically.

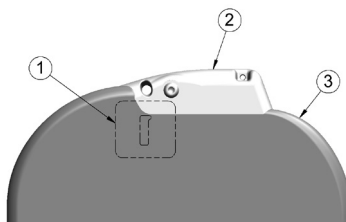


Figure 23: Location of the x-ray ID; 1: x-ray identifier location, 2: header, 3: pulse generator case

Table 16: Mechanical Specifications

Model	Dimensions W x H x D (mm)	Mass (g)	Volume (cm³)	Connector Type^a
A209	83.1 x 69.1 x 12.7	130	59.5	SQ-1 S-ICD connector (non- standard)

^a The EMBLEM S-ICD pulse generator is compatible with both the Cameron Health Model 3010 subcutaneous electrode and the EMBLEM S-ICD subcutaneous electrode.

The pulse generator has a case electrode surface area of 111.0 cm².

Material Specifications

- Case: hermetically sealed titanium, coated with titanium nitride
- Header: implantation-grade polymer
- Power Supply: lithium-manganese dioxide cell; Boston Scientific; 400530

Table 17: Programmable Parameters

Parameter	Programmable Values	Nominal (as shipped)
Shock Zone	170 bpm – 250 bpm (steps of 10 bpm)	220 bpm
Conditional Shock Zone	Off, 170 bpm – 240 bpm (If On, at least 10 bpm less than Shock Zone)	200 bpm
S-ICD Pulse Generator Mode	Shelf, Therapy On, Therapy Off	Shelf
Post-shock Pacing	On, Off	Off
Sensing Configuration	Primary: Proximal electrode ring to device Secondary: Distal electrode ring to device Alternate: Distal electrode ring to proximal electrode ring	Primary
Max Sensing Range	x1 (± 4 mV) x2 (± 2 mV)	x1
Manual Shock	10 – 80 J (in steps of 5 J)	80 J
Smart Charge	Resets to nominal	0 extensions
Polarity	Standard: Phase 1 Coil (+) Reverse: Phase 1 Coil (-)	Standard

Table 18: Non-Programmable Parameters (Shock Therapy)

Parameter	Value
SHOCK THERAPY	
Delivered Energy	80 J
Peak Shock Voltage (80 J)	1328 V
Shock Tilt (%)	50%
Waveform Type	Biphasic
Maximum Number of Shocks per episode	5 shocks
Charge Time to 80 J (BOL/ERI)^a	≤10 sec / ≤15 sec ^b
Sync Time Out	1 sec
Shock Sync Delay	100 ms
Post-Shock Blanking Period	1600 ms

^a Charge time is one portion of the overall time-to-therapy. BOL refers to beginning of life.

^b Under typical conditions.

Table 19: Non-Programmable Parameters (Post-Shock Pacing)

Parameter	Value
POST-SHOCK PACING	
Rate	50 ppm
Pacing Output	200 mA
Pulse Width (each phase)	7.6 ms
Waveform	Biphasic
Polarity (first phase)	Standard: Phase 1 Coil (+)
Mode	Inhibited Pacing
Duration	30 sec
Post-Pace Blanking Period/ Refractory Period	750 ms (first pace pulse) 550 ms (subsequent pace pulses)
Runaway Protection	120 ppm

Table 20: Non-Programmable Parameters (Detection/Rhythm Discrimination, Fibrillation Induction, Sensing, Capacitor Reform Schedule, Internal Warning System)

Parameter	Value
DETECTION/RHYTHM DISCRIMINATION	
X/Y for Initial Detection	18/24 intervals
X/Y for Redetection	14/24 intervals
Confirmation Before Shock	3 – 24 consecutive tachy intervals
Refractory Period	Fast 160 ms, Slow 200 ms
FIBRILLATION INDUCTION	
Frequency	50 Hz
Output	200 mA
Time out After Activation	10 sec
SENSING	
Minimum Sensing Threshold^a	.08 mV
CAPACITOR REFORM SCHEDULE	
Automatic Capacitor Reformation Interval	Approximately 4 months ^b
INTERNAL WARNING SYSTEM	
High Impedance (sub-threshold)	> 400 Ohms
High Impedance (delivered shock)	> 200 Ohms
Maximum Charge Time out	44 sec

^a With 10 Hz sine wave

^b Reform can be delayed if capacitor was charged due to sustained/non-sustained arrhythmia in past 4 months

Table 21: *Episode Data Parameters*

Parameter	Value
Treated Episodes	25 stored
Untreated Episodes	20 stored
Maximum Length per S-ECG Episode	128 sec
Captured S-ECG Report	Up to 15 (12 sec each)

Table 22: *Stored Patient Information*

Patient Information (Stored Data)
Patient Name
Physician Name
Physician Contact Information
Device Model Number
Device Serial Number
Electrode Model Number
Electrode Serial Number
Patient Notes









Table 23: Magnet Specifications (Model 6860)













Component	Specification
Shape	Circular
Size	Approximate Diameter: 2.8 in (7.2 cm) Thickness: 0.5 in (1.3 cm)
Content	Ferrous alloys coated with epoxy
Field Strength	90 gauss minimum when measured at a distance of 1.5 in (3.8 cm) from magnet surface

Note: Specifications are also applicable to the Cameron Health magnet Model 4520.

Definitions of Package Label Symbols

Table 24: Packaging Symbols: EMBLEM S-ICD Pulse Generator

Symbol	Description	Symbol	Description
	Sterilized using ethylene oxide		Date of manufacture
	Dangerous voltage		Use by
	Serial number		Temperature limitation
	Open here		Consult instructions for use

Symbol	Description	Symbol	Description
	Do not reuse		Manufacturer
	Do not resterilize		Do not use if package is damaged
	Literature enclosed		Package contents
	Uncoated device		Lot number
	Pulse generator		SQ-1 S-ICD connector (non-standard)
	Torque wrench		Reference number

S-ICD System and Pacemaker Interaction

Warning: *Using multiple pulse generators could cause pulse generator interaction, resulting in patient injury or a lack of therapy delivery. Test each system individually and in combination to help prevent undesirable interactions.*

Interaction between the S-ICD System and a temporary or permanent pacemaker is possible and can interfere with the identification of tachyarrhythmias in several ways.

- If the pacing pulse is detected, the S-ICD System may not adjust sensitivity appropriately, fail to sense a tachyarrhythmia episode and/or not deliver therapy.
- Pacemaker sensing failure, lead dislodgment or failure to capture could result in the sensing of two asynchronous sets of signals by the S-ICD System, causing the rate measurement to be faster, and may result in delivery of unnecessary shock therapy.
- Conduction delay may cause the device to oversense the evoked QRS and T-wave resulting in unnecessary shock therapy.

Unipolar pacing and impedance-based features can interact with the S-ICD. This includes bipolar pacemakers that revert or reset to the unipolar pacing mode. Refer to the manufacturer's pacemaker manual for considerations when configuring a bipolar pacemaker for compatibility with an S-ICD.

Prior to implantation, follow the patient screening tool procedure to assure that the patient's paced S-ECG signal passes the criteria.

The following test procedure aids in determining S-ICD System and pacemaker interaction after implantation:

Warning: *Always have external defibrillation equipment and medical personnel skilled in CPR available during implant and follow-up testing. If not terminated in a timely fashion, an induced ventricular tachyarrhythmia can result in the patient's death.*

Note: *If implanting a pacemaker with an existing S-ICD System, program the S-ICD System to Therapy Off during the implantation and initial testing of the pacemaker.*

During the testing procedure, program the pacemaker output to maximum and asynchronously pace in the pacing mode to which the pacemaker will be permanently programmed (e.g., DDO for most dual-chamber modes and VOO for single-chamber modes).

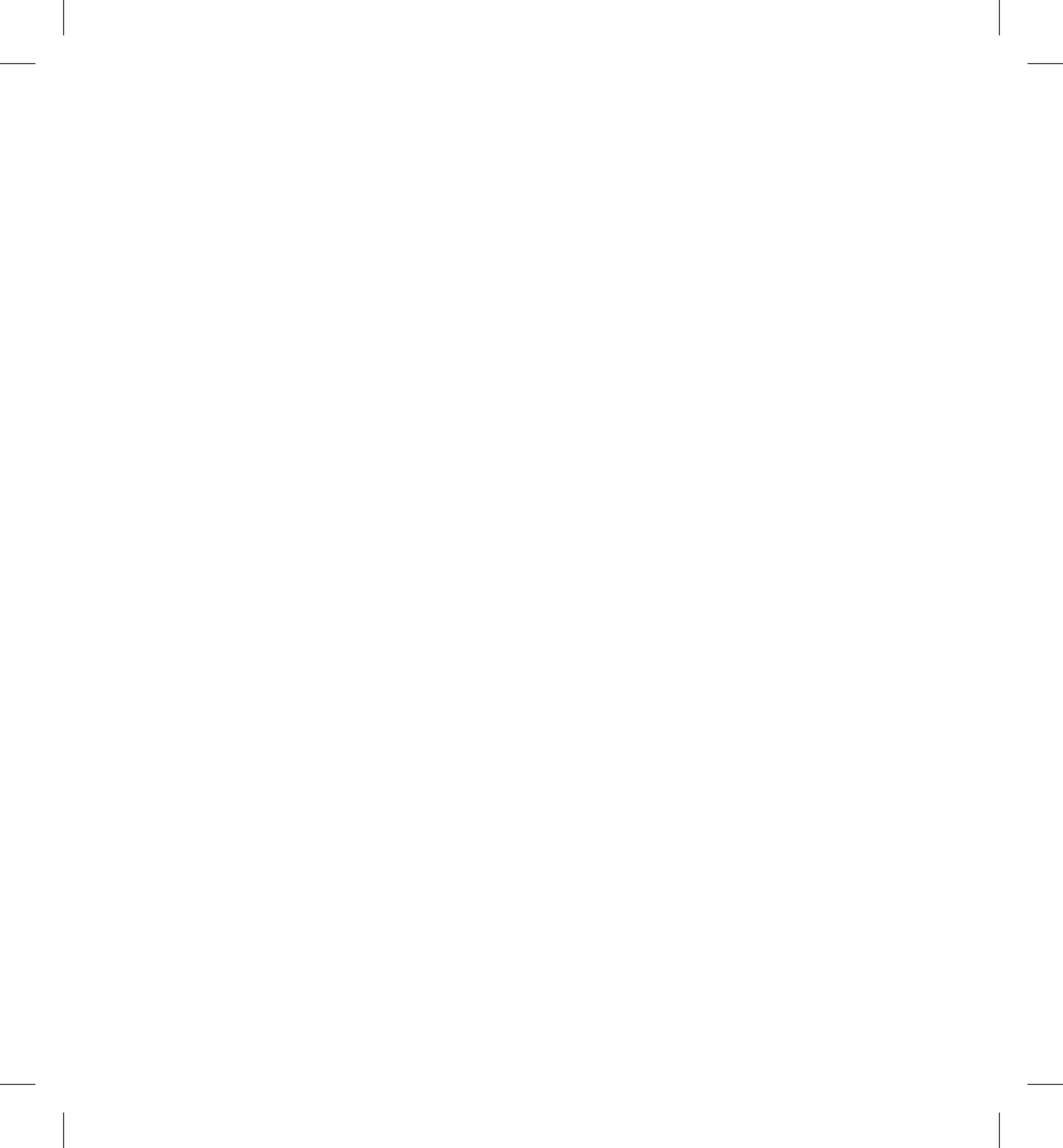
1. Complete the S-ICD System setup procedure.
2. Observe the S-ECG for any pacing artifacts. If any pacing artifacts are present and larger in amplitude than the R-wave, use of the S-ICD System is not recommended.
3. Induce the tachyarrhythmia and observe the S-ECG markers to determine appropriate detection and delivery of therapy.

-
4. If inappropriate sensing is observed as a result of the device sensing the pacing artifact, reduce the pacemaker's pacing output and retest.

In addition, pacemaker operation may be affected by the S-ICD System therapy delivery. This could alter the pacemaker's programmed settings or damage the pacemaker. In this situation, most pacemakers will conduct a memory check to determine if the parameters for safe operation were affected. Further interrogation will determine if programmed pacemaker parameters are altered. Refer to the manufacturer's pacemaker manual for implantation and explantation considerations.

Warranty Information

A limited warranty certificate for the pulse generator is available at www.bostonscientific.com. For a copy, contact Boston Scientific using the information on the back cover.



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359278-001 EN US 2014-09

