DEPARTMENT OF HEALTH & HUMAN SERVICES Food and Drug Administration

Memorandum For Record

18 October 2010

I. DOCUMENT REVIEW SUMMARY

Document	
Number(s)	1) P980035/S166 (master); 2) P980016/S237; 3) P890003/S191
Type	Pre-Market Approval Supplement (PMA/S)
Change	Modifications to Application SW, FW, post sterilization manufacturing test SW.
Link	Documents not posted in appropriate eRoom due to access issues. Please move folder. Files placed at: http://eroom.fda.gov/eRoom/CDRH7/PMAsModulesHDEs2010/0_1025b
PMA Devices	
Name(s)	1) Entrust ICD Family; 2) Enrythm IPG; 3) Carelink DDMA Software, CareLink Monitor
Models	1) D153ATG, D153VRC, D154ATG, D154VRC, D154DRG; 2) P150DR; 3) 2491, 2490G
Sponsor	Medtronic, Inc.
Review Milestones	
22 April 2010	PMA/S Received by FDA
22 July 2010	Amendment to PMA/S Received by FDA
Design Change: Implanted Device, Programmer, DDMA	
1. Implanted Device – RAM Parameters, FW, Specifications, Labeling	
2. Programmer – RAM Parameters, SW, Specifications, Labeling	
3. DDMA– SW	
Evaluation	
1. Implanted Device – No issue noted.	
2. Programmer – No issue noted.	
3. DDMA– No issue noted.	
Recommendation – APPR	
CTS Designation: APPR - Approved [Close]	

Team Member	Role	Responsibility	Recommendation
[redacted], PE	Scientific Reviewer, Lead	• Evaluated PMA Supplement • Generated Memoranda	• APPR
[redacted], PhD	Biomedical Engineer	• Unavailable per message dated	• None
[redacted]	CSO, OC	• Approve	• APPR
[redacted]	Supervisory CSO, OC	• Unavailable per message dated	• None
[redacted]	Supervisory CSO, OC	• Acceptable to Approve	• APPR

Lead Reviewer: [redacted]
ODE/DCD/PDLB

Signature: _____

Chief: [redacted]
ODE/DCD/PDLB

Signature: _____

II. DOCUMENT REVIEW DETAIL

A. Background

Medtronic submitted the Supplements (180-Day) to the subject Pre-market Approval Applications in order to request approval for modifications to the Medtronic EnRhythm™ pulse generators and Entrust Family of ICD's (D153ATG, D153VRC, D154ATG, D154VRC, D154DRG) Programmer Application Software Model 9987 (Version 7.2), Model 2491 Device Data Management Application (DDMA) (part of Model 2490G Carelink Monitor System), firmware, and the post sterilization manufacturing test software.

The proposed modifications address field complaints related to the Delta 26H battery. The complaints indicated that the in-office battery voltage measurement was lower than the Elective Replacement Indicator (ERI)/Recommended Replacement Time (RRT) threshold voltage; however the ERI indicator had not been set. Medtronic confirmed that the low battery voltage readings as displayed during an in-office interrogation are due to increased battery resistance caused by a resistive film formation on the titanium cathode current collector.

B. Description

Medtronic failed to provide device/system descriptions within the Supplement or supporting documentation. While the product line is fairly well understood by members of the division, each submission should include such a description.

C. Indications for Use

The Indications for Use for the Protecta Family of Devices has not changed, per Medtronic (Page 1-13): "The current approved indications for use for the EnRhythm devices are as follows: The device is indicated for the following:

• Rate adaptive pacing in patients who may benefit from increased pacing rates concurrent with increases in activity

• Accepted patient conditions warranting chronic cardiac pacing include:

- Symptomatic paroxysmal or permanent second- or third-degree AV block
- Symptomatic bilateral bundle branch block
- Symptomatic paroxysmal or transient sinus node dysfunctions with or without associated AV conduction disorders
- Bradycardia-tachycardia syndrome to prevent symptomatic bradycardia or some forms of symptomatic Tachyarrhythmias

The device is also indicated for dual chamber and atrial tracking modes in patients who may benefit from maintenance of AV synchrony. Dual chamber modes are specifically indicated for treatment of conduction disorders that require restoration of both rate and AV synchrony, which include:

• Various degrees of AV block to maintain the atrial contribution to cardiac output

• VVI intolerance (for example, pacemaker syndrome) in the presence of persistent sinus rhythm

Antitachycardia pacing (ATP) is indicated for termination of atrial tachyarrhythmias in bradycardia patients with one or more of the above pacing indications.

Atrial rhythm management features such as Atrial Rate Stabilization (ARS), Atrial Preference Pacing (APP), and Post Mode Switch Overdrive Pacing (PMOP) are indicated for the suppression of atrial tachyarrhythmias in bradycardia patients with atrial septal lead placement and one or more of the above pacing indications."

D. Review History

The PMA/S was received by the FDA on 22 April 2010 by the FDA. The Amendment to the PMA/S was received on 22 July 2010. Please refer to the CTS Interactive Review Log (Attachment A) for details related to the review. Issues discussed are detailed in sections E and F of this memorandum.

E. Proposed Design Changes

The proposed changes serve to correct field issues related to the 26H Delta battery. Medtronic proposed SW, FW, Specification, and Labeling changes within the implanted devices, programmer and DDMA to correct noted failures so that the observed device performance is clearly conveyed to the end user. Following is a summary of proposed changes discussed during the teleconference (Attachment C) and detailed within the submission, pages 1-15 through 1-17:

Implanted Device:

1. ***Random Access Memory Update***: The RAM update increases the ERI voltage threshold from 2.59V to 2.81V4 and increases the End of Life (EOL) voltage threshold from (b) (4) V to [redacted] V.

2. ***Firmware***: The device firmware update employs a RAMware download from the 2090 programmer application to incorporate a secondary ERI trigger criteria based on differences in battery voltage measured under low and high current drain conditions. The Delta Voltage (Delta V) measurement algorithm represents an indirect measurement of battery impedance. After the existing automatic nightly battery voltage measurement at (b) (4) completes, two additional measurements will be taken:
    a. One measurement will be taken at low current drain conditions similar, but somewhat higher, than the current drain during the automatic nightly measurement. Another measurement will be taken after the application of a known additional higher current drain of approximately (b) (4) µA.
    b. The difference between the high and low current measurements will be compared against a threshold value (~(b) (4) Ohms). If the DeltaV threshold is exceeded for (b) (4) out of (b) (4) measurements, ERI will be set as shown in Figure 1 below:

(b) (4)

[redacted]

3. ***Specification Changes***: Specification changes include updating the Delta 26H battery specification, Hardware Requirements Specification (HRS) and Device Requirements Specification (DRS) to reflect the modifiations.

4. ***Manufacturing Post Sterilization Test***: The following modifications serve to update the manufacturing post sterilization test:
    a. The ERI voltage of 2.81 V and EOL voltage of (b) (4) V will be updated in Electrically Erasable Programmable Read-Only Memory (EEPROM).
    b. The ERI and EOL values are permanently stored in the EEPROM, and the EnRhythm device copies the ERI threshold to RAM, where the firmware uses the value to identify an ERI condition and the device acts accordingly.
    c. Prior to shipping, the RAM ERI value will be temporarily changed to a shipping ERI value of 2.59 V. This change is necessary to mitigate the risk of ERI being triggered due to cold temperature prior to implant. The ERI is converted to 2.81 V during the initial application software programmer interrogation. Per Medtronic: "since the Entrust ICDs and EnRhythm IPGs share the same post sterilization test application, Entrust devices are also included in this submission. However, there were no parameter changes for the EnTrust devices."

5. ***Labeling:*** Associated labeling updates. Some additional labeling changes were made to make existing labeling consistent with other Medtronic products.

Programmer Software

1. ***Random Access Memory Update***: Update the 2090 programmer software (SW) application and device firmware (via a RAMware download) to prevent battery voltage measurements from occurring when telemetry is active. The SW will continue to display the most recent successful nightly battery voltage measurement. The programmer SW will disable the manual battery voltage measurement command that occurs when users initiate a lead impedance test.
2. ***Software:***
    a. ***ERI Imminent Warning***: Update the 2090 programmer SW application to display an "ERI Imminent" warning pop-up message and Quicklook observation for devices with battery voltage at or below 2.81V at the time of the ERI threshold change. The purpose of this change is to help the clinician better manage their patients as the device approaches the VVI 65 settings and to schedule a replacement as applicable.
    b. During a routine non-invasive programming session with the Medtronic 2090 programmer, the device firmware that is loaded by the SW application will update the ERI voltage threshold (2.59V to 2.81V) in RAM, along with the Cyclic Redundant Check (CRC) checksum.
        i. For all subsequent battery voltage measurements, the device will apply the updated ERI threshold of 2.81V to identify potential ERI condition. In addition, the SW applications will reload the device firmware if it is lost due to a POR.
        ii. During internal Medtronic testing a potential software issue was noted with the previously approved ERI voltage threshold update. When the ERI voltage threshold change as outlined above was made, the process is executed in two phases- 1) an update to the ERI voltage threshold and 2) an update to a Cycle Redundancy Check (CRC). This implementation programmed the ERI voltage threshold first, followed by a second downlink to program the CRC. Executing the implementation in two phases could result in a device POR. The process is now loaded in a single phase. This change was made to correct an internal Medtronic software error.
3. ***Specification Changes:*** Updating the Software Requirements Specification (SRS) and XML Translation Utility Software Requirements Specification (XMLTU SRS).

4. ***Labeling Modifications***. Some additional labeling changes were made to make existing labeling consistent with other Medtronic products.

Device Data Management Application (DDMA) Model 2491:

XMLTU: Updated the EnRhythm XMLTU files with the nightly battery voltage, the DeltaV measurement trend, the high current measurement trend and the DeltaV ERI flag. This change is not visible to the clinician.

F. Evaluation of Design

Consults were requested from [redacted], PhD, Biomedical Engineer, ODE\DCD\PDLB, [redacted], Consumer Safety Officer, OC/DOEB/CREB; [redacted], Biomedical Engineer, ODE\DCD\PDLB; and [redacted], Supervisory Consumer Safety Officer, OC/DOEB for the subject review. Due to workload demands, only personnel from the Office of Compliance were able to contribute to the review.

Implanted Device:

1. ***Random Access Memory Update***: The update serves to modify parameters so that ERI and EOL voltages are increased—and thus a warning is issued earlier.

2. ***Firmware***: Medtronic adequately tested the firmware in accordance with existing protocols. No issues is noted with the documentation or the procedure

3. ***Specification Changes***: Review of the modifications support the updated parameters.

4. ***Manufacturing Post Sterilization Test***: The procedure reflects existing protocol in terms of updating the EEPROM and testing the device prior to final packaging. No issue is noted.

5. ***Labeling:*** Associated labeling updates. Some additional labeling changes were made to make existing labeling consistent with other Medtronic products.

Programmer Software

1. ***Random Access Memory Update***: The modification decreases the number of telemetry events.

2. ***ERI Imminent Warning***: The modification serves to add an additional warning. No issue is noted.

3. Update Procedure: The update procedure presents no concern since FW will be modified during routine office visits. During a routine non-invasive programming session with the Medtronic 2090 programmer, the device firmware that is loaded by the SW application will update the ERI voltage threshold (2.59V to 2.81V) in RAM, along with the Cyclic Redundant Check (CRC) checksum.

4. ***Specification changes:*** Review of the modifications support the updated parameters.

5. ***Associated labeling updates***. The labeling presents only minor modifications and aligns with existing products.

Device Data Management Application (DDMA) Model 2491: The update simply incorporates report of the DeltaV with other parameters. No issue is noted.

G. Recommendation

I recommend that the proposed, be deemed **APPR - Approved [Closed]**.

However, since the modifications serve to address parameters (i.e. symptoms) surrounding the issue and do not correct the battery, future post-market events associated with the 26H Delta battery should be monitored for significant trend-ing events. Further, evaluation the following items should be evaluated internally and conveyed to Medtronic as deemed appropriate and necessary: Furthermore, particular attention should be focused on incorporation of additional telemetry features since Medtronic indicated increased telemetry as a primary root cause for battery depletion is increased telemetry.

1. Each supplement submitted to FDA is a standalone document. Thus, submission of all elements (indications for use, description, etc) necessary for review is critical.
2. All documents defined within the FDA SW Guidance must be submitted in order to evaluate proposed changes.