SUMMARY OF SAFETY AND EFFECTIVENESS DATA (SSED)

I. GENERAL INFORMATION

Device Generic Name:	Catheter, Percutaneous, Cardiac Ablation, For Treatment Of Atrial Fibrillation
Device Trade Name:	QDOT MICRO™ System
Device Procode:	OAE, OAD
Applicant's Name and Address:	Biosense Webster, Inc. 31 Technology Drive, Suite 200 Irvine, CA, USA 92618
Date(s) of Panel Recommendation:	None
Premarket Approval Application (PMA) Number:	P210027
Date of FDA Notice of Approval:	November 23, 2022

II. INDICATIONS FOR USE

The QDOT MICRO™ System is indicated for use in catheter-based cardiac electrophysiological mapping (stimulating and recording) and, when used in conjunction with a compatible radiofrequency generator, for the treatment of:

- Type I atrial flutter in patients age 18 or older
- Drug refractory recurrent symptomatic paroxysmal atrial fibrillation, when used with compatible three-dimensional electroanatomic mapping systems.

The Biosense Webster QDOT MICRO™ Catheter provides a real-time measurement of contact force between the catheter tip and heart wall, as well as location information when used with the CARTO® 3 Navigation System.

III. CONTRAINDICATIONS

QDOT MICRO™ Catheter

Do not use this catheter:

1. If the patient has had a ventriculotomy or atriotomy within the preceding twelve weeks because the recent surgery may increase the risk of perforation.

2. In patients with a myxoma or an intracardiac thrombus as the catheter could precipitate an embolus.

3. In patients with prosthetic valves as the catheter may damage the prosthesis.

4. In the coronary arterial vasculature due to risk of damage to the coronary arterial vasculature.

5. In patients with an active systemic infection because this may increase the risk of cardiac infection.

6. Via the transseptal approach in a patient with an interatrial baffle or patch because the opening could persist and produce an iatrogenic atrial shunt.

7. Via the retrograde trans-aortic approach in patients who have had aortic valve replacement.

8. With a long sheath or short introducer < 8.5 F in order to avoid damage to the catheter shaft.

TX eco EXT Cable

There are no known contraindications for this cable.

TX eco Cable

There are no known contraindications for this cable.

nGEN™ RF Generator

There are no known contraindications for this cable.

nGEN™ Pump

There are no known contraindications for this cable.

IV. WARNINGS AND PRECAUTIONS

The warnings and precautions can be found in the QDOT MICRO™ System labeling.

V. DEVICE DESCRIPTION

The QDOT MICRO™ System includes:

- QDOT MICRO™ Uni-directional Navigation Catheter (D-1394-XX-S)
- QDOT MICRO™ Bi-directional Navigation Catheter (D-1395-XX-S)
- TX eco EXT Cable (D-1357-03-S)

- TX eco Cable (D-1401-02)
- nGEN™ RF Generator (D-1384-02)
- nGEN™ Pump (D-1397-02)

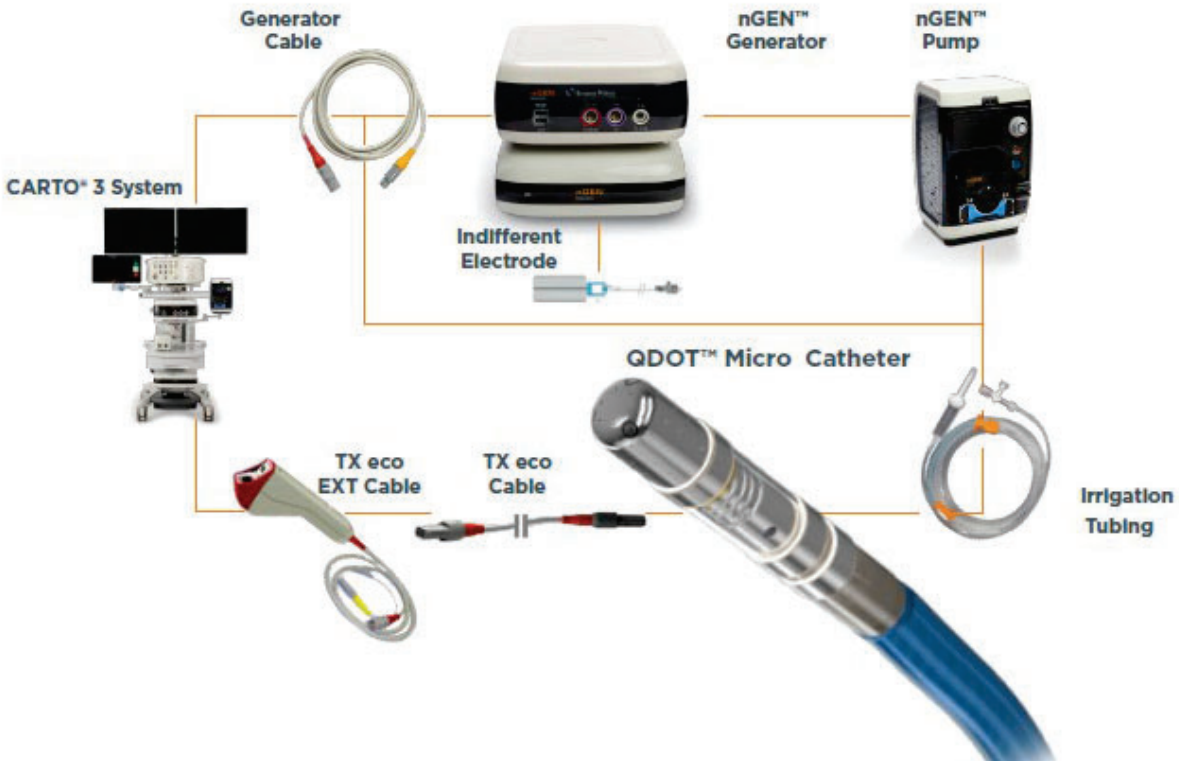

Figure 1: QDOT MICRO™ System

QDOT MICRO™ Catheter

The Biosense Webster QDOT MICRO™ Catheter is a steerable multi-electrode luminal catheter with a deflectable tip designed to facilitate electrophysiological mapping of the heart and to transmit radiofrequency (RF) energy to the catheter tip electrode for ablation purposes. The catheter shaft measures 7.5 F with 8 F ring electrodes.
For ablation, the catheter is used in conjunction with a compatible RF generator and a dispersive pad (indifferent electrode). The catheter has force-sensing technology that provides a real-time measurement of contact force between the catheter tip and the heart wall.

The catheter has a high-torque shaft with a deflectable tip section containing an array of electrodes which includes a 3.5 mm tip dome. All of the electrodes may be used for recording and stimulation purposes. The tip electrode serves to deliver RF energy from the generator to the desired ablation site. The tip electrode and ring electrodes are made from noble metals. The catheter incorporates six thermocouple temperature sensors and three ECG electrodes that are embedded in the 3.5 mm tip electrode. A thumb knob (uni-directional catheters) or Rocker Lever (bi-directional catheters) are used to deflect the tip. The high-torque shaft also allows the plane of the curved tip to be rotated to facilitate

accurate positioning of the catheter tip at the desired site. For both the uni-directional and bi-directional catheters, there are a variety of curve types available.

At the proximal end of the catheter, a saline input port with a standard Luer fitting terminates from the open lumen. This saline port serves to permit the injection of normal saline to irrigate the tip electrode. During ablation, heparinized normal saline is passed through the internal lumen of the catheter and through the tip electrode, to irrigate and cool the ablation site as well as the electrode tip. A compatible irrigation pump is used to control the saline irrigation. The catheter interfaces with standard recording equipment and a compatible RF generator via accessory extension cables with the appropriate connectors.

This catheter features a location sensor embedded in the tip section that transmits location and contact force information to the CARTO® 3 Navigation System. An appropriate reference device is required for location reference position purposes. For information on using the catheter in mapping procedures and for information on appropriate reference devices, refer to the user manual for the CARTO® 3 Navigation System. For further description of the operation of the irrigation pump, the generator, and the CARTO® 3 Navigation System, refer to the applicable instructions for use.

The QDOT MICRO™ Catheter operates in a temperature control mode of ablation. The recommended ablation parameter settings when using the QDOT MICRO™ Catheter and related accessory devices for ablation in the atria are reported in **Table 1**.

Table 1: Recommended Parameters

Power Mode	**QMODE***		**QMODE+**
Power (W)	25-35	36-50	90
Target Electrode Temperature (°C)	50	50	60
RF application time (s)	Up to 60	Up to 60	4
Nominal Irrigation flow rate (ml/min)**	4***	15***	8

* RF applications on the left atrial posterior wall using QMODE should not exceed 35 W in power and 30 sec in duration.
**A minimum flow rate of 2 mL/min during mapping is recommended
*** The irrigation flow rate is set by the generator and automatically adjusted between 4ml/min or 15ml/min to reach and maintain the set maximum power within the target electrode temperature.

TX eco EXT Cable

This cable provides a means to connect a Biosense Webster electrophysiology catheter to the appropriate equipment. The cable may be reused subject to the cleaning and sterilization restrictions in this document. The intended users of this cable are appropriately trained personnel in a fully equipped electrophysiology laboratory.

TX eco Cable

The TX *eco* Cable is used with a TX eco EXT Cable to connect a Biosense Webster therapeutic catheter to the Patient Interface Unit (PIU) of the CARTO® System (Version 6 and later).

The TX eco Cable communicates data from the Biosense Webster therapeutic catheter to the CARTO® System and the RF generator. The information communicated is listed below.

- Force signals
- Location signals
- IC signals from the 3 microelectrodes in the tip of the catheter (for catheters with microelectrodes only)
- Temperature measurements from the 6 thermocouples in the tip of the catheter

nGEN™ RF Generator

The nGEN™ Generator is intended for cardiac ablation applications. Its purpose is to generate radiofrequency (RF) energy for a specified duration, to produce lesions at the site of application in order to interrupt abnormal electrical conduction pathways in the cardiac tissue.

The nGEN™ Generator consists of the following components:

- nGEN™ Monitor: The monitor is a touch screen computer that contains the nGEN™ Generator software. The monitor has a control knob and physical start and stop buttons. An optional second monitor may also be used.

- nGEN™ Console: The console produces and controls the delivery of RF energy. The console also connects to and communicates with therapeutic catheters and other devices.

- nGEN™ Power Supply Unit: The power supply unit provides power to the console.

- nGEN™ Pedal: The pedal is an alternate way to start and stop an ablation session.

- Cables: The nGEN™ Generator is shipped with cables for connecting the generator components to each other and to other devices.

For a detailed list of the generator components and connectivity to other devices, refer to the Instructions For Use.

nGEN™ Pump

The nGEN™ Pump is a peristaltic pump designed for use by electrophysiology laboratory staff in cardiac electrophysiology procedures. The pump delivers irrigation solution from a connected irrigation solution bag via a compatible irrigation tubing set to a compatible irrigated catheter.

The pump has an intuitive user interface that allows easy manual control of the pump's functions. Alternatively, the pump may be connected to a compatible RF generator so that the pump's irrigation flow rates (high and low) can be controlled by the generator. When the pump is connected to a generator that is capable of fully controlling the pump, the generator automatically sets the irrigation flow rate based on the connected catheter type, changes the flow rate when the delivery of RF energy starts and stops, and monitors the flow rate.

Only compatible accessories and devices provided by or recommended by Biosense Webster may be used with the nGEN™ Pump. For a detailed list of connectivity to other devices, refer to the Instructions For Use.

VI. ALTERNATIVE PRACTICES AND PROCEDURES

There are several other alternatives for the correction of type I atrial flutter (also known as typical atrial flutter) and/or drug-refractory, recurrent, symptomatic paroxysmal atrial fibrillation.

- Treatment with medicines that help control the rate and/or rhythm of the heart and other medicines that reduce the likelihood of clots forming (known as medical or pharmacologic therapy).
- Cardioversion to restore the heart's normal rhythm (with electrical shock or medicine).
- Implantable devices that control the rate of the heart.
- Surgical procedures that may include other devices approved or cleared in the United States.
- Catheter ablation with other devices approved in the United States.

Each alternative has its own advantages and disadvantages. A patient should fully discuss these alternatives with his/her physician to select the method that best meets expectations and lifestyle.

VII. MARKETING HISTORY

The QDOT MICRO™ System has been approved for commercial distribution in Canada, Europe, Asia, Latin America, Middle East, and Australia. The QDOT MICRO™ System has not been withdrawn from marketing for any reason related to its safety or effectiveness.

A Biosense Webster Inc. sponsored Pre-Launch Evaluation in Europe of an earlier CE Marked version of the QDOT MICRO™ System was initiated in November 2019. During this Pre-Launch Evaluation, a higher than anticipated number of incidents involving "char" formation were noted for the nGEN™ Generators using QMODE+™ with the QDOT MICRO™ Catheter. No patient adverse events were reported related to the issue.

A Voluntary Field Safety Notice was generated for Europe in January 2021, which resulted in modifications to the earlier CE Marked version of the QDOT MICRO™ System. The subsequent revised version of the QDOT MICRO™ System is the subject of this PMA Submission.

VIII. POTENTIAL ADVERSE EFFECTS OF THE DEVICE ON HEALTH

Below is a list of the potential adverse effects (e.g., complications) associated with the use of the device.

- Acute Respiratory Distress Syndrome (ARDS)
- Air embolism
- Allergic reaction
- Anemia
- Anesthesia reaction
- Arrhythmias
- Atelectasis
- Atypical atrial flutter
- AV fistula
- Bleeding complications
- Cardiac arrest
- Cardiac perforation/tamponade
- Cardiac Thromboembolism
- Cerebrovascular accident (CVA)
- Chest pain/discomfort
- Complete heart block, requiring temporary or permanent pacing
- Component damage to ICD or implantable pacemaker
- Congestive heart failure
- Coronary artery dissection
- Coronary artery occlusion
- Coronary artery spasm
- Death
- Deep venous thrombosis
- Dislodgement of ICD or permanent pacing leads
- Disseminated intravascular coagulation
- Dyspnea
- Embolism
- Endocarditis

- Esophageal injury (including atrio-esophageal fistula)
- Exacerbation of pre-existing atrial fibrillation, or other arrhythmia
- Expressive aphasia
- Hair loss due to anesthesia
- Heart failure
- Hematuria
- Hemorrhage
- Hemothorax
- Hypertension/Hypotension
- Hypoxia
- Increase in frequency or duration of episodes of typical atrial flutter
- Increased phosphokinase level
- Infection, localized or systemic
- Injury to skin, muscle, connective tissue due to body position, electrical cardioversion, etc.
- Laceration
- Leakage of air or blood into the lungs or other organs due to perforation
- Local hematoma/ecchymosis
- Mobile strands in the inferior vena cava
- Myocardial infarction (MI)
- Obstruction or perforation or damage to the vascular system
- Pericardial effusion/tamponade
- Pericarditis
- Phlebitis
- Phrenic nerve damage
- Pleural effusion
- Pneumonia
- Pneumothorax
- Pseudoaneurysm
- Pulmonary edema
- Pulmonary embolism
- Pulmonary vein stenosis
- Pulmonary vein dissection
- Renal failure
- Respiratory depression/failure
- Retroperitoneal hematoma
- Rhabdomyolysis, including that produced by body position or propofol
- Seizure
- Shortness of Breath
- Skin burns due to cardioversion, tape, etc.
- Sore throat
- Syncope/Dizziness
- Temperature elevation
- Thrombocytopenia

- Thromboembolism
- Transient ischemic attack (TIA)
- Unintended complete/incomplete AV, sinus node or other heart block or damage
- Urinary tract injury or infection related to the urinary catheter
- Valvular damage/insufficiency
- Vasovagal reactions
- Vison change
- Volume overload
- Worsening obstructive, restrictive, or other form of pulmonary disease
- X-ray radiation injury of skin, muscle and/or organ
- Laceration
- Leakage of air or blood into the lungs or other organs due to perforation
- Local hematoma/ecchymosis
- Mobile strands in the inferior vena cava
- Myocardial infarction
- Obstruction or perforation or damage to the vascular system
- Pericardial effusion/tamponade
- Pericarditis
- Phlebitis
- Phrenic nerve damage
- Pleural effusion
- Pneumonia
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- Vasovagal reactions
- Vison change
- Volume overload
- Worsening obstructive, restrictive, or other form of pulmonary disease
- X-ray radiation injury of skin, muscle and/or organ cardioversion, etc.

For the specific adverse events that occurred in the clinical study, please see Section X below.

IX. SUMMARY OF NON-CLINICAL STUDIES

A. Laboratory Studies

QDOT MICRO™ Catheter

Design verification tests (DVT) were performed to evaluate the performance and integrity of the QDOT MICRO™ Catheters following three times ethylene oxide (EtO) sterilization, the equivalent of three (3) years of accelerated aging, thermal cycling and simulated transportation. Testing evaluated visual attributes; deflection characteristics such as curve profile and stability; electrical characteristics including DC resistance and isolation, RF impedance and leakage current; irrigation pressure and flow; thermocouple temperature accuracy; biosensor and force sensor integrity; mechanical integrity including tip stiffness and tip buckle force; integrity following simulated use conditioning; handle temperature; and finally, catheter strength and integrity following destructive tests. Results of DVT tests concluded that the QDOT MICRO™ Catheters met design requirements and are safe for use.

Proof of Design (POD) studies were performed to evaluate the contact force technology. Separate studies evaluated contact force magnetic sensor location accuracy; contact force accuracy using CARTO® 3; contact force influence on ECG signal quality; distortion in the magnetic field when paramagnetic material is placed in close proximity to the coils thus interfering with force readings and causing Shaft Proximity Interference (SPI); overall catheter testing including location-related (electromagnetic sensor) tests, force-related (contact force sensor) tests and system-level tests to ensure that the catheter met requirements when connected to a CARTO®3 system. Results of POD tests concluded that the QDOT MICRO™ Catheters met design requirements and are safe for use.

Electromagnetic compatibility testing was conducted on the QDOT MICRO™ System.

Biocompatibility testing was performed on components of the Uni-Directional and Bi-Directional QDOT MICRO catheters. Device design, materials, construction, and manufacturing environment were evaluated. All biocompatibility testing of the QDOT MICRO Catheter has met the ISO 10993-1 biocompatibility testing

requirements for external communicating devices with circulating blood for limited contact time (≤24 hours).

The sterilization process incorporates all phases of sterilization (preconditioning, sterilization and aeration) within the sterilization chamber. Sterility assurance was verified to exceed a sterility assurance level (SAL) of 1 x 10-6. Sterilization validations met the requirements of ISO 11135. Residual results for EO and ECH are within allowable limits per ISO 10993-7.

The packaging has been validated to maintain a sterile barrier for three years. Product shelf life for the QDOT MICRO Catheters has been validated for three years. The product will bear a three-year shelf life on its labeling.

TX eco EXT Cable

Design verification testing was performed to evaluate the performance and integrity of the TX eco EXT Cable following three times EtO sterilization, twenty times steam sterilization, the equivalent of three (3) years of accelerated aging, thermal cycling and simulated transportation. Testing evaluated DC resistance and leakage; flex; connector making cycles; connector retention force; dielectric withstand; tensile strength; visual inspection. Results of DVT tests concluded that the TX eco EXT Cable met design requirements and is safe for use.

Testing was performed to validate the electrical functionality of the TX eco EXT Cable. Results concluded that the TX eco EXT Cable met design requirements and is safe for use.

Electromagnetic compatibility testing was conducted on the QDOT MICRO™ System.

The safety of the material used for the TX eco EXT Cable was evaluated. All materials have been shown to have documentation supporting USP Class VI compliance, ISO-10993-1 certification, and/or statements of non-toxicity. This evaluation determined that the biocompatibility results for the eco Interface Cable (cleared under K113213) can be adopted for the TX eco EXT Cable.

The TX eco EXT Cable is EtO sterilized. Assessment of device packaging, construction, manufacturing environment and gas penetration were evaluated. Based on the equivalency evaluation in AAMI TIR28:2016, the TX eco EXT Cable is suitable for adoption into the BWI sterilization cycle to achieve a SAL of 1 x 10-6 or better per ISO 11135. Residual results for EO and ECH are within allowable limits per ISO 10993-7.

Reuse of the cable is subject to the cleaning and sterilization restrictions in the IFU. Testing performed demonstrated the suitability of the manual cleaning and disinfection procedures provided in the IFU. The TX eco EXT Cable has been

validated for twenty times re-sterilization by EtO or steam. Testing performed in compliance with AAMI TIR12 met the minimum SAL of 10-6 for both methods and EO residual levels are within allowable limits per ISO 10993-7.

The packaging for the TX eco EXT Cable is identical to the FDA cleared CARTO 3 System eco Interface Cable packaging. The packaging has been validated to maintain a sterile barrier for three years. Product shelf life for the TX eco EXT Cable has been validated for three years. The product will bear a three-year shelf life on its labeling.

TX eco Cable

Design verification testing was performed to evaluate the performance and integrity of the TX eco Cable following thermal cycling and simulated transportation. Testing evaluated the temperature functionality with the QDOT Micro Catheter and nGEN RF Generator; verified the legacy functionalities and microelectrode attributes of magnetic, ECG, ACL, and force; verified the electrical functionality of the TX eco Cable and QDOT Micro Catheter PCB. Results of DVT tests concluded that the TX eco Cable met design requirements and is safe for use.

Testing was performed to validate electrical functionality of the hardware. Electromagnetic compatibility testing was conducted on the QDOT MICRO™ System.

Software validation testing was successfully conducted for the TX eco Cable firmware. There are no unresolved anomalies from the outcome of the testing.

Packaging validation testing was conducted for the TX eco Cable kit in compliance with ASTM D4169-16. The test samples were subjected to environmental conditions per IEC 60068-2. Testing evaluated dry heat; damp heat; temperature cycling; low temperature; handling; vehicle stacking; loose load vibration; low air pressure; and concentrated impact. Results of the tests concluded that the TX eco Cable met design requirements.

The TX eco Cable will be distributed and labeled with a 3-year useful life. Reliability analysis for the TX eco Cable was performed and this analysis calculated the mean time between failures (MTBF). Based on the predicted MTBF and an added safety factor, the useful life is set to 3 years.

nGEN™ Generator

Usability testing was conducted to inform the user interface design of the nGEN generator. The study confirmed the improved user interface does not introduce user hazards or use errors.

Power, impedance and temperature (PIT) profile of the nGEN Generator was compared to the profile of the nMARQ Generator. The results of the PIT testing concluded that the

nGEN generator exhibits similar performance at clinically significant ranges of impedance, power and temperature conditions and are expected to create similar lesions.

Electromagnetic compatibility testing was conducted on the QDOT MICRO™ System with satisfactory results.

nGEN™ Pump

Testing was performed to verify the system timing accuracy performance in different fault scenarios to guarantee proper system operation, efficient treatment and to avoid any risks of damage to the patient. Such processes include system's faults detection, internal and external communication protocols, commands response time, synchronization between system components, Real-Time (RT) data update rate, etc. The timing requirements and specifications of the nGEN Generator and nGEN Pump were verified, and all the performed tests passed.

B. Animal Studies

QDOT™ Micro Catheter

An ablation characteristics study was conducted in a canine thigh muscle preparation to compare lesions created by the QDOT MICRO Catheter to the currently approved THERMOCOOL® SMARTTOUCH™ (ST) and THERMOCOOL® SMARTTOUCH™ SF (STSF) Catheters. The generators used were the nMARQ™ Generator for ablations with the QDOT catheter and the SmartAblate™ Generator with the ST and STSF catheters. The QDOT MICRO Catheter was operated in QMODE (35W/60s/4**ml/min and 50W/30s/15**ml/min) and QMODE+ (90W/4s/8ml/min). Lesions created with the QMODE settings were compared to the lesions created with ST catheter operated at 35W/60s/15ml/min and 50W/60s/15ml/min settings, and the STSF catheter operated at 35W/60s/30ml/min and 50W/60s/30ml/min settings. Lesions created with the QMODE+ setting were compared with the lesions created with STSF catheter operated at 30W/30s/8ml/min and 50W/10s/15ml/min settings. The comparison was made at contact force levels of 10g and 30g, and in perpendicular and parallel catheter orientations.

Ablation characteristics evaluated included:

i. Quantification of lesion size (maximum depth, maximum diameter, surface diameter)
ii. Quantification of coagulum, char, and steam pop incidence (percent incidence of coagulum, char, steam pop)

The results of the ablation characteristics study showed that maximum depth, maximum diameter, and surface diameter of the lesions created with the QDOT

MICRO Catheter operated in QMODE were similar to the lesions created with the commercially available ST and STSF catheters.

Maximum depth of the lesions created with the QDOT MICRO Catheter operated in QMODE+ was significantly shallower than lesions created with the STSF Catheter.

Table 2: Lesion Depths Measured with QDOT MICRO Catheter

Maximum lesion depth (mm) (N=10)	Force 10g			Force 30g		
	QDOT 90W/4s	STSF 50W/10s	STSF 30W/30s	QDOT 90W/4s	STSF 50W/10s	STSF 30W/30s
Parallel	3.7 ±0.3	4.9 ±0.6	6.2 ±0.4	4.6 ±0.5	5.8 ±0.4	6.9 ±0.5
Perpendicular	3.9 ±0.5	5.0 ±0.5	5.9 ±0.6	4.6 ±0.3	5.6 ±0.5	6.7 ±0.5

Maximum diameter of the lesions created with the QDOT MICRO Catheter operated in QMODE+ was similar to the lesions created with the STSF Catheter operated at the 50W/10s/15ml/min setting and significantly smaller than lesions created with the STSF Catheter operated at the 30W/30s/8ml/min setting.

Surface diameter of the lesions created with the QDOT MICRO Catheter operated in QMODE+ was similar to the lesions created with the STSF Catheter.

Occurrence of steam pop, thrombus, and char was similar for the QDOT MICRO Catheter operated in QMODE and QMODE+ when compared to the respective control devices.

An additional study was conducted in a canine thigh muscle preparation to compare the nGEN Generator to the nMARQ Generator when used to create lesions with the QDOT MICRO Catheter in QMODE and QMODE+. Lesion maximum depth, maximum diameter and surface diameter as well as functional performance were assessed.

The study demonstrated that the nGEN Generator creates similar lesions (in maximum depth, maximum diameter and surface diameter) and has similar functional performance (incidence of char/coagulum) when compared to the nMARQ Generator.

A chronic animal study was conducted to validate the performance of the QDOT Micro Catheter interfacing with the Carto 3 V7.1 System, the nGEN RF Generator, TX eco Cable and TX eco EXT Cable. Testing performed under this protocol was GLP compliant and conformed to the guidelines for nonclinical laboratory studies as described in the Code of Federal Regulations, 21 Part 58.

The objective of the GLP study was to demonstrate the overall safety of the nGEN Generator when ablating at clinically relevant anatomical locations like pulmonary veins and right atrium isthmus, when used with the QDOT MICRO Ablation catheter, dongle, Carto 3 Navigation system, nGEN irrigation pump, catheter interface cable, an EP Recording System, and standard pacing system in a chronic beating heart model.

Additionally, overall performance of the nGEN™ generator was evaluated using a 7-point Likert Scale.

nGEN™ Generator and nGEN™ Pump

Testing was conducted to demonstrate the equivalence of the nGEN Generator to the nMARQ generator when used to create ablations with QDOT Micro catheter ablation modules in a well-established canine thigh muscle model. In conclusion, the testing indicated the lesion characteristics were equivalent between both generators at all tested parameters and the generators create equivalent lesions.

A chronic safety assessment was conducted to demonstrate the overall safety of the nGEN generator when ablating at clinically relevant anatomical locations when used with the QDOT MICRO Catheter and system components (the QDOT MICRO Ablation catheter, Tx eco Cable, Carto 3 Navigation system, nGEN irrigation pump, catheter interface cable, an EP Recording System, and standard pacing system) in a chronic beating heart model. In addition, the overall performance of the generator was evaluated using a 7-point Likert scale. The testing concluded the nGEN Generator in conjunction with the QDOT catheter was able to deliver RF energy effectively and safely to all intended anatomical locations without any generator related adverse events.

Lesion formation with the QDOT Micro ablation catheter and nGEN generator with the QMODE+ settings were evaluated in an in-vitro model. The study concluded that ablating at incrementally increasing power settings within the QMODE+ ablation module resulted in a linear increase in lesion dimensions.

X. SUMMARY OF PRIMARY CLINICAL STUDY

The applicant performed a clinical study to establish a reasonable assurance of safety and effectiveness of percutaneous catheter ablation with the QDOT MICRO™ System for the treatment of type I atrial flutter and drug-refractory, recurrent, symptomatic paroxysmal atrial fibrillation in the US under IDE G180176. Data from this clinical study were the basis for the PMA approval decision. A summary of the clinical study is presented below.

A. Study Design

Patients were treated between September 28, 2016, and April 26, 2018. The database for this PMA reflected data collected through October 5, 2018, and included 191 patients. There were 25 investigational sites.

The study was a prospective, single arm, unblinded, multicenter, pivotal clinical study. The study intended to enroll up to 185 subjects. The study used a Bayesian adaptive design to assess early success at one interim analysis performed six months after enrollment was completed and when 30% of subjects in the study completed twelve months of follow-up. There was no active control group.

1. Clinical Inclusion and Exclusion Criteria

Enrollment in the Q-FFICIENCY Trial (NCT03775512) was limited to patients who met the following inclusion criteria:

1) Symptomatic paroxysmal AF who had at least one AF episode electrocardiographically documented within one (1) year prior to enrollment. Documentation may include electrocardiogram (ECG); Transtelephonic monitoring (TTM), Holter monitor or telemetry strip.

2) Failed at least one (1) antiarrhythmic drug (AAD) (class I or III) as evidenced by recurrent symptomatic AF, contraindicated, or intolerable to the AAD.

3) Age 18 years or older.

4) Signed Patient Informed Consent Form (ICF).

5) Able and willing to comply with all pre-, post-, and follow-up testing and requirements.

Patients were not permitted to enroll in the Q-FFICIENCY Trial if they met any of the following exclusion criteria:

1) Previous surgical or catheter ablation for atrial fibrillation.

2) AF secondary to electrolyte imbalance, thyroid disease, or reversible or noncardiac cause.

3) Patient on amiodarone at any time during the past 3 months prior to enrollment.

4) Previously diagnosed with persistent or long-standing persistent AF and/or Continuous AF > 7 days

5) Coronary artery bypass graft (CABG) surgery within the past 6 months (180 days).

6) Valvular cardiac surgical/percutaneous procedure (i.e., ventriculotomy, atriotomy, valve repair or replacement and presence of a prosthetic valve).

7) Any carotid stenting or endarterectomy within the last 6 months.

8) Documented LA thrombus on imaging (within 48 hr prior of a study ablation procedure).

9) LA size > 50 mm (parasternal long axis view).

10) Left ventricular ejection fraction (LVEF) < 40%.

11) Contraindication to anticoagulation (e.g. heparin)

12) History of blood clotting or bleeding abnormalities

13) MI/percutaneous coronary intervention (PCI) within the past 2 months (60 days)

14) Documented thromboembolic event (including TIA) within the past 12 months (365 days)

15) Rheumatic Heart Disease

16) Uncontrolled heart failure or NYHA function class III or IV

17) Severe mitral regurgitation (Regurgitant volume ≥ 60 mL/beat, Regurgitant fraction ≥ 50%, and/or Effective regurgitant orifice area ≥ 0.40cm2)

18) Awaiting cardiac transplantation or other cardiac surgery within the next 12 months (365 days)

19) Unstable angina

20) Active systemic infection or sepsis

21) Diagnosed atrial myxoma or presence of an interatrial baffle or patch.

22) Presence of implanted implantable cardioverter-defibrillator/cardiac resynchronization therapy-defibrillator (ICD/CRT-D).

23) Significant pulmonary disease, (e.g., restrictive pulmonary disease, constrictive or chronic obstructive pulmonary disease) or any other disease or malfunction of the lungs or respiratory system that produces chronic symptoms.

24) Gastroesophageal Reflux Disease (GERD; active requiring significant intervention not including OTC medication)

25) Significant congenital anomaly or medical problem that in the opinion of the investigator would preclude enrollment in this study.

26) Women who are pregnant (as evidenced by pregnancy test if pre-menopausal), lactating, or who are of child bearing age and plan on becoming pregnant during the course of the clinical investigation.

27) Enrollment in an investigational study evaluating another device, biologic, or drug

28) Presence of intramural thrombus, tumor or other abnormality that precludes vascular access, or manipulation of the catheter.

29) Presence of an inferior vena cava filter.

30) Presenting contra-indication for the devices (e.g. transthoracic echocardiogram (TTE), computed tomography (CT), etc.) used in the study, as indicated in the respective instructions for use.

31) Life expectancy less than 12 months

2. Follow-up Schedule

All patients were scheduled to return for follow-up examinations at 1 month, 3 months, 6 months, and 12 months postoperatively. Discharged patients received a telephone call at 7 days post-ablation procedure to assess any occurrence of Primary Adverse Events. The first 40 consecutively enrolled subjects were included in a computed tomography/magnetic resonance angiography (CT/MRA) substudy and underwent a CT/MRA at 3 months to assess for the incidence of pulmonary vein (PV) stenosis.

The key timepoints are shown below in the tables summarizing safety and effectiveness.

3. Clinical Endpoints

With regards to safety, the primary safety endpoint was the incidence of any primary adverse event occurring within 7 days of the AF ablation procedure (initial or repeat procedure) using the QDOT MICRO™ catheter, except atrio-esophageal fistula and PV stenosis, which may also be considered as primary adverse events if occurring greater than 7 days and up to 90 days post the ablation procedure. Primary adverse events included the following: Death, myocardial infarction, PV stenosis, phrenic nerve injury/diaphragmatic paralysis, atrio-esophageal fistula, TIA, stroke/CVA, thromboembolism, pericarditis, cardiac tamponade/perforation, vagal nerve injury, major vascular access complications/bleeding, pulmonary edema (respiratory insufficiency), and heart block.

With regards to effectiveness, the primary effectiveness endpoint was freedom from documented AF, atrial tachycardia (AT), or atrial flutter (AFL) recurrence during the evaluation period (Day 91 through Day 365) and freedom from the following

failures modes: (1) acute procedure failure, (2) repeat ablation failure, or (3) antiarrhythmic drug failure.

Table 3: Failure Modes for Primary Effectiveness Endpoint

Failure Mode	Criteria
Acute procedural	• Failure to confirm entrance block in all pulmonary veins post-procedure • Use of a non-study catheter to treat left atrial ablation targets and cavo-tricuspid isthmus
Repeat ablation	• >2 repeat ablation procedures with the study catheter during the 3-Month blanking period (Day 0-90) after the index ablation procedure. • Use of a non-study catheter to treat study arrhythmia ablation targets during the blanking period. • Any repeat ablation procedure during the Evaluation Period.
Antiarrhythmic drug	• Taking a new Class I or III AAD for AF or a previously failed Class I or III AAD at a greater than the highest ineffective historical dose for AF during the evaluation period.

With regards to success/failure criteria, the study used performance goals for the primary safety and primary effectiveness analyses. The safety performance goal was 14%. The effectiveness performance goal was 50% at 12 months.

4. Ablation Protocol

A circumferential anatomical approach was used to isolate all PVs. Confirmation of entrance block in all PVs was required by the protocol with a 20-minute waiting period after the last PV encircling lesion, during isoproterenol infusion and/or after adenosine bolus.

The study ablation procedure used both QMODE and QMODE+ temperature control modes. The primary mode of ablation for PVI was QMODE+. QMODE was used for PVI once the investigator deemed QMODE+ unable to complete PVI. QMODE was used primarily for RF application outside the PV ostia and for touch-up of the PVI, if necessary.

Table 4: QMODE+ RF and Flow Rate Settings during RF applications

Power (W)	Target Temp (ºC)		Cut-off Temp (ºC)		Nominal Irrigation Flow Rate (mL)
	Range	Maximum allowed	Range	Maximum allowed	
90†	40-60	60	60-70	70	8

† RF applications at this setting were limited to 4 sec. It was recommended to use lower target temperature setting for the posterior wall RF applications.

Table 5: QMODE Ablation Parameters*

Power (W)	Target Temp (ºC)		Cut-off Temp (ºC)		Nominal Irrigation Flow Rate (mL)
	Range	Recommended	Range	Recommended	
25-35	45-50	50	50-55	55	4
36-50	45-50	50	50-55	55	15

*The study protocol recommended a maximum duration of 60 sec for RF applications using QMODE in general. For RF applications on the left atrial posterior wall, a maximum power of 35 W and a maximum duration of 30 sec were recommended.

B. Accountability of PMA Cohort

At the time of database lock, of 191 patients enrolled in the PMA study, 85% of patients are available for analysis at the completion of the study, the 12-month post-operative visit.

Table 6: Subject Accountability and Disposition

Subject Enrollment	n
Enrolled Subjects	191
Excluded Subjects	14
Study Catheter Inserted	177
Discontinued Subjects	2
RF Energy Delivered with Study Catheter	175
Death	1
Withdrawn	7
Early Termination Subjects	0
Lost to Follow Up Subjects	5
Completed Subjects	162

Table 7: Subject Classifications

Disposition	Definition
Enrolled Subjects	Subjects who signed the informed consent
Excluded Subjects	Subjects who were enrolled but never underwent insertion of the study catheter
Discontinued Subjects	Subjects who had the investigational catheter inserted but did not undergo ablation (i.e., no RF energy was delivered via the study device). These discontinued subjects were followed up for 3 months.

Disposition	Definition
Lost to Follow-up Subjects	Subjects who were enrolled, but contact was lost after the most recent follow-up visits (despite 3 documented attempts to contact the subject)
Withdrawn / Early Termination Subjects	Subjects who withdrew consent for study participation or were withdrawn by the investigator or were terminated from the study prior to completion of all follow-up visits
Completed Subjects	Enrolled subjects who completed the 12-month follow-up visit and were not excluded, discontinued, withdrawn, early terminated, expired, or lost to follow-up from the study before the final study visit

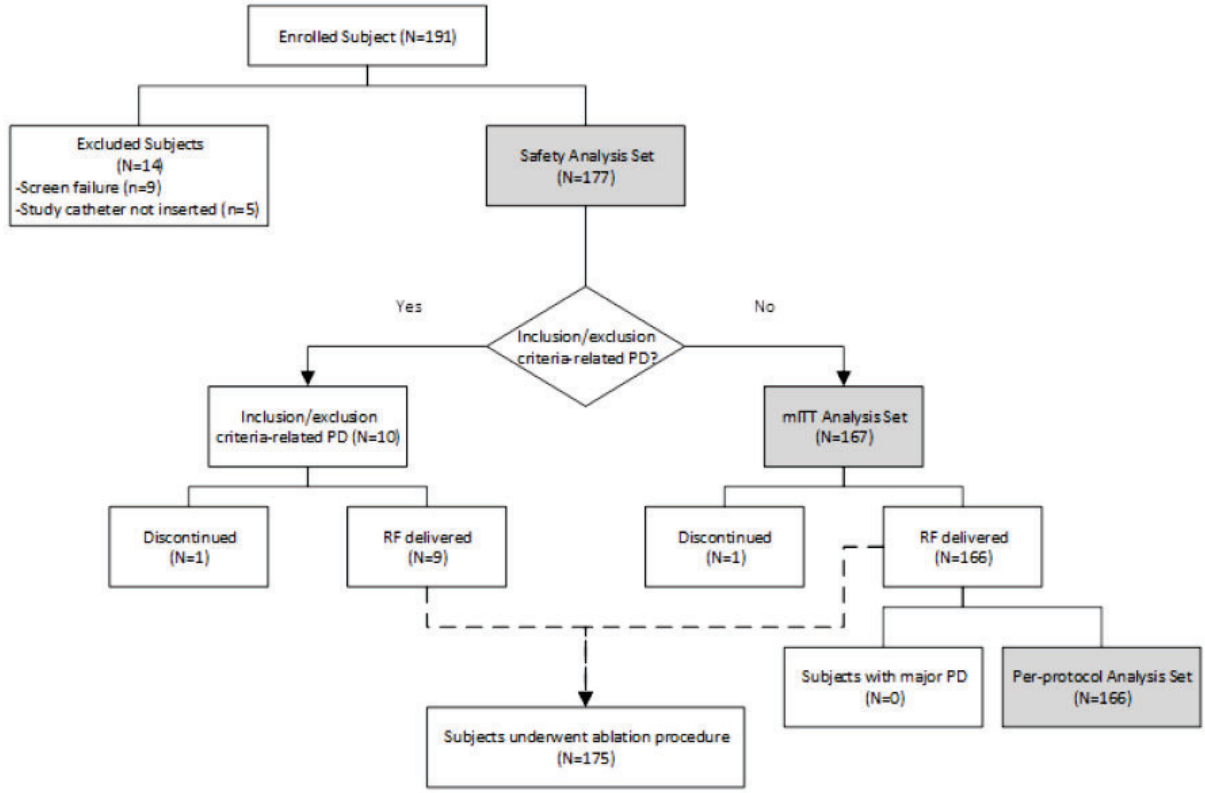

Figure 2: Subject Enrollment and Analysis Sets Flowchart

C. Study Population Demographics and Baseline Parameters

The demographics of the study population are typical for a catheter ablation study performed in the US.

Table 8: Subject Demographics (Enrolled Subjects, N=191)

Variables	All Subjects (N=191)	Safety Analysis Set (N=177)	mITT Analysis Set (N=167)	Per-Protocol Analysis Set (N=166)
Age (years) [1]				
n	191	177	167	166
Mean	63.5	63.3	63.1	63.2
SD	10.69	10.88	11.00	11.03
Min/Max	24 / 83	24 / 83	24 / 83	24 / 83
Sex, n/N (%)				
Male	116 / 191 (60.7)	106 / 177 (59.9)	101 / 167 (60.5)	101 / 166 (60.8)
Female	75 / 191 (39.3)	71 / 177 (40.1)	66 / 167 (39.5)	65 / 166 (39.2)
Race n (%)				
White, n/N (%)	166 / 191 (86.9)	157 / 177 (88.7)	149 / 167 (89.2)	148 / 166 (89.2)
Black or African American	7 / 191 (3.7)	6 / 177 (3.4)	6 / 167 (3.6)	6 / 166 (3.6)
Asian	1 / 191 (0.5)	1 / 177 (0.6)	1 / 167 (0.6)	1 / 166 (0.6)
Race not reported	17 / 191 (8.9)	13 / 177 (7.3)	11 / 167 (6.6)	11 / 166 (6.6)
Ethnicity, n/N (%)				
Not Hispanic or Latino	164 / 191 (85.9)	154 / 177 (87.0)	146 / 167 (87.4)	145 / 166 (87.3)
Hispanic or Latino	8 / 191 (4.2)	6 / 177 (3.4)	6 / 167 (3.6)	6 / 166 (3.6)
Not reported	19 / 191 (9.9)	17 / 177 (9.6)	15 / 167 (9.0)	15 / 166 (9.0)

Table 9: Medical History (Enrolled Subjects, N=191)

Medical History	Enrolled Subjects (N=191)	Safety Analysis Set (N=177)	mITT Analysis Set (N=167)	Per-Protocol Analysis Set (N=166)
Cardiovascular	156 / 191 (81.7)	143 / 177 (80.8)	135 / 167 (80.8)	134 / 166 (80.7)
Congestive heart failure	16 / 191 (8.4)	10 / 177 (5.6)	9 / 167 (5.4)	9 / 166 (5.4)
Coronary artery disease	39 / 191 (20.4)	36 / 177 (20.3)	33 / 167 (19.8)	33 / 166 (19.9)
Vascular disease	25 / 191 (13.1)	23 / 177 (13.0)	22 / 167 (13.2)	22 / 166 (13.3)
Myocardial infarction	13 / 191 (6.8)	12 / 177 (6.8)	10 / 167 (6.0)	10 / 166 (6.0)
Hypertension	131 / 191 (68.6)	122 / 177 (68.9)	116 / 167 (69.5)	115 / 166 (69.3)
Cardiomyopathy	15 / 191 (7.9)	11 / 177 (6.2)	10 / 167 (6.0)	10 / 166 (6.0)

Medical History	Enrolled Subjects (N=191)	Safety Analysis Set (N=177)	mITT Analysis Set (N=167)	Per-Protocol Analysis Set (N=166)
Left ventricular hypertrophy	1 / 191 (0.5)	1 / 177 (0.6)	1 / 167 (0.6)	1 / 166 (0.6)
Significant valvular disease	3 / 191 (1.6)	1 / 177 (0.6)	1 / 167 (0.6)	1 / 166 (0.6)
Thromboembolic Events	20 / 191 (10.5)	18 / 177 (10.2)	16 / 167 (9.6)	16 / 166 (9.6)
Transient ischemic attack	5 / 191 (2.6)	4 / 177 (2.3)	3 / 167 (1.8)	3 / 166 (1.8)
Stroke	6 / 191 (3.1)	5 / 177 (2.8)	5 / 167 (3.0)	5 / 166 (3.0)
Pulmonary embolus	2 / 191 (1.0)	2 / 177 (1.1)	2 / 167 (1.2)	2 / 166 (1.2)
Diabetes	37 / 191 (19.4)	36 / 177 (20.3)	33 / 167 (19.8)	33 / 166 (19.9)
Obstructive Sleep Apnea	50 / 191 (26.2)	46 / 177 (26.0)	44 / 167 (26.3)	44 / 166 (26.5)
CPAP Use	36 / 191 (18.8)	34 / 177 (19.2)	33 / 167 (19.8)	33 / 166 (19.9)
CHA_2DS_2-VASc score	2.4 ± 1.51	2.4 ± 1.53	2.4 ± 1.49	2.4 ± 1.50
AF History (months)	48.6 ± 73.63	49.6 ± 75.29	51.7 ± 76.92	51.9 ± 77.11
PAF Episodes Within 12 Months	24.9 ± 89.91	25.2 ± 92.80	26.0 ± 95.22	25.7 ± 95.38
AAD Failed - Class I&III	1.2 ± 0.50	1.2 ± 0.50	1.2 ± 0.52	1.2 ± 0.52
Arrhythmia other than Atrial Fibrillation	87 / 191 (45.5)	81 / 177 (45.8)	73 / 167 (43.7)	73 / 166 (44.0)
Left/right Atrial Tachycardia (AT)	8 / 191 (4.2)	8 / 177 (4.5)	7 / 167 (4.2)	7 / 166 (4.2)
Supraventricular Tachycardia (SVT)	22 / 191 (11.5)	20 / 177 (11.3)	14 / 167 (8.4)	14 / 166 (8.4)
Atrial flutter (AFL)	43 / 191 (22.5)	41 / 177 (23.2)	40 / 167 (24.0)	40 / 166 (24.1)
AVNRT	0 / 191 (0.0)	0 / 177 (0.0)	0 / 167 (0.0)	0 / 166 (0.0)
Accessory pathway	0 / 191 (0.0)	0 / 177 (0.0)	0 / 167 (0.0)	0 / 166 (0.0)
Ventricular tachycardia	2 / 191 (1.0)	2 / 177 (1.1)	2 / 167 (1.2)	2 / 166 (1.2)
LA Diameter (mm)	38.06 ± 6.042	37.95 ± 5.917	38.09 ± 5.974	38.16 ± 5.917
LVEF (%)	59.4 ± 7.31	59.6 ± 7.02	59.7 ± 6.98	59.7 ± 6.99

Values in table represent n/N (%) or mean ± SD, as appropriate.

D. Safety and Effectiveness Results

1. Safety Results

The analysis of safety was based on the mITT cohort of 167 patients/procedures, etc. available for the 12-month evaluation.

Adverse effects that occurred in the PMA clinical study:

- Cardiac Tamponade/Perforation
- Phrenic Nerve Injury/Diaphragmatic Paralysis
- Major Vascular Access Complication/Bleeding

Table 10: Summary of Primary Safety Endpoint Analysis mITT Analysis Set, N=167)

Subjects with Primary Safety Events	6
Subjects without Primary Safety Events	160
Missing	1
Raw Incidence	3.6%
Posterior Mean*	4.2%
95% BCI	(1.7%, 7.7%)
Posterior Probability* that rate < 0.14	1.0000
Threshold to Pass	0.9750
Pass?	Yes

2. Effectiveness Results

The analysis of effectiveness was based on the 166 evaluable patients at the 12-month time point. Key effectiveness outcomes are presented in Tables 11 to 15.

Table 11: Summary of Primary Effectiveness Endpoint Analysis based on the Interim analysis and Final Analysis Per-Protocol Analysis Set, N=166)

	Jun-22, 2020 Data	**Aug-14, 2020 Data**	**Final Data**
	Based on 3-piece exponential model	**Based on 3-piece exponential model**	**Based on Beta-Binomial Model**
Kaplan-Meier Estimate (39 weeks)	0.765	0.778	0.767
Posterior Mean	0.745	0.755	0.759
95% BCI	(0.666, 0.815	(0.684, 0.820)	(0.690, 0.823
Posterior Probability that $P_E > 0.50$	1.0000	1.0000	1.0000
Threshold to Pass	0.9975	0.9975	
Pass	Yes	Yes	

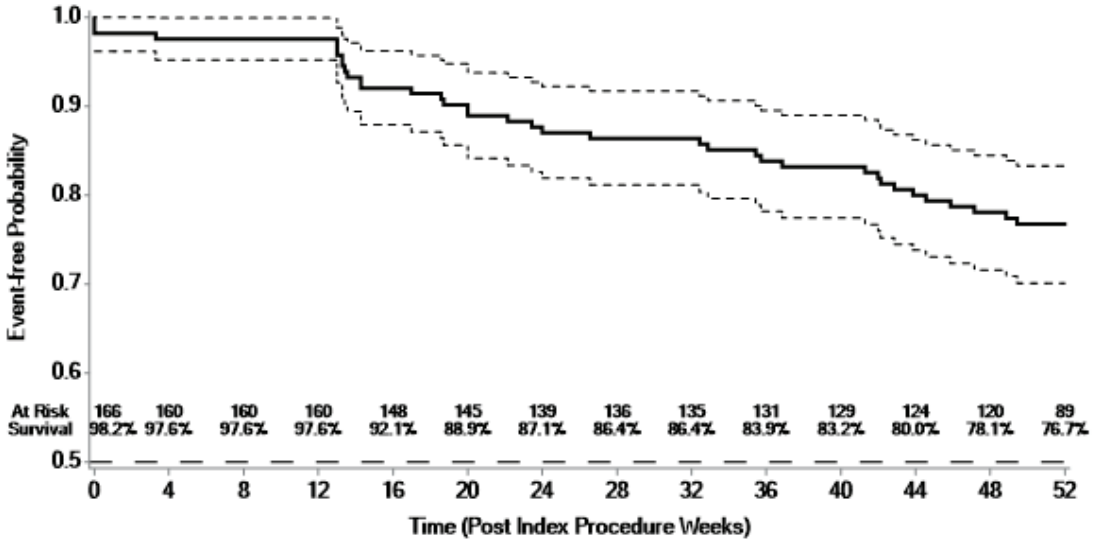

Figure 3: Kaplan-Meier Analysis of Time to First Primary Effectiveness Failures Post Procedure (Per-Protocol Analysis Set, N=166)

Ablation of Cavo-Tricuspid Isthmus (CTI)

Among a total of 175 subjects who received RF ablation using the study device in the pivotal trial, 47 underwent CTI ablation using the study device only (n = 45), a non-study catheter only (n = 1), or both (n = 1) during the index procedure per study protocol for typical atrial flutter documented either before or during the procedure. Protocol recommended QMODE mode was used to ablate the CTI in all 33 subjects with ablation mode data available and one of the 33 subjects also received ablations in the CTI using the QMODE+ mode.

Among the 46 subjects who received CTI ablation using the study catheter, 44 (95.7%) had bidirectional CTI block confirmed, and the remaining two subjects either did not achieve bidirectional CTI block (n=1) or had missing information about CTI block (n = 1).

Among the 46 subjects who received CTI ablation using the study catheter, none had a primary AE, 3 had a total of 3 serious adverse events and 11 had a total of 12 non-serious adverse events within 30 days after a study procedure. None of these serious adverse events or non-serious adverse events was adjudicated as study device-related; while 9 non-serious adverse events were adjudicated as ablation procedure related.

Among the 46 subjects who received CTI ablation using the study catheter, 2 had documented atrial flutter recurrence during follow-up. The type of recurrent atrial flutter was atypical atrial flutter in one subject and undetermined in another because it was only documented on transtelephonic monitor (TTM).

3. Subgroup Analyses

The following preoperative characteristics were evaluated for potential association with outcomes: sex, age, and ablation mode.

Table 12: Primary Effectiveness Endpoint by Sex (Per-Protocol Analysis Set, N=166)

Primary Effectiveness Endpoint	Male	Female
Primary Effectiveness Endpoint Success		
n/N	75 / 95	44 / 61
%	78.9%	72.1%

Table 13: Primary Safety Endpoint by Sex (Safety Analysis Set, N=177)

Primary Safety Endpoint	Male	Female
Primary AE		
n/N	3 / 106	3 / 70
%	2.8%	4.3%

Table 14: Primary Safety Endpoint by Age (Safety Analysis Set, N=177)

Primary Safety Endpoint	Age < 65 years	Age ≥ 65 years
n/N	0 / 82	6 / 94
%	0.0%	6.4%

Table 15: Primary Safety Endpoint by PV Ablation Mode (Safety Analysis Set, N=177)

Primary Safety Endpoint	QMODE+ Only	QMODE+ and QMODE
Primary AE		
n/N	3 / 95	3 / 79
% [1]	3.2%	3.8%

4. Pediatric Extrapolation

In this premarket application, the pivotal study enrollment included subjects aged 18 years or older. The basis for approval including Transitional Adolescents between age 18 and 22 did not require any extrapolation.

XI. FINANCIAL DISCLOSURE

The Financial Disclosure by Clinical Investigators regulation (21 CFR 54) requires applicants who submit a marketing application to include certain information concerning the compensation to, and financial interests and arrangement of, any clinical investigator conducting clinical studies covered by the regulation. The pivotal clinical study included 46 investigators of which none were full-time or part-time employees of the sponsor and 3 had disclosable financial interests/arrangements as defined in 21 CFR 54.2(a), (b), (c) and (f) and described below:

- Compensation to the investigator for conducting the study where the value could be influenced by the outcome of the study: 0
- Significant payment of other sorts: 3
- Proprietary interest in the product tested held by the investigator: 0
- Significant equity interest held by investigator in sponsor of covered study: 0

The applicant has adequately disclosed the financial interest/arrangements with clinical investigators. Statistical analyses were conducted by FDA to determine whether the financial interests/arrangements had any impact on the clinical study outcome. The information provided does not raise any questions about the reliability of the data.

XII. PANEL MEETING RECOMMENDATION AND FDA'S POST-PANEL ACTION

In accordance with the provisions of section 515(c)(3) of the act as amended by the Safe Medical Devices Act of 1990, this PMA was not referred to the Circulatory System Devices Panel, an FDA advisory committee, for review and recommendation because the information in the PMA substantially duplicates information previously reviewed by this panel.

XIII. CONCLUSIONS DRAWN FROM PRECLINICAL AND CLINICAL STUDIES

A. Effectiveness Conclusions

Results of the Q-FFICIENCY clinical study and the ablation characteristics study conducted in a canine thigh muscle preparation demonstrated a reasonable assurance that the QDOT MICRO System is effective for the treatment of symptomatic drug refractory paroxysmal AF and type 1 atrial flutter. The clinical study met its primary effectiveness endpoint.

B. Safety Conclusions

The risks of the device are based on nonclinical laboratory and/or animal studies as well as data collected in a clinical study conducted to support PMA approval as described above. The pivotal study met its pre-specified safety performance goal with a primary safety event rate of 3.6% [95% CI: 1.7% - 7.7%]. The reported primary safety events included two cardiac tamponade/perforation events, two phrenic nerve injury events, and three major vascular access complications. There were no unanticipated adverse device effects or device or procedure-related death, myocardial infarction, stroke, severe PV stenosis, or atrio-esophageal fistula. Procedural complications reported in the study were similar in nature and in frequency to other paroxysmal AF ablation catheter trials. Among the 46 subjects who received concomitant CTI ablation using the study catheter for documented typical atrial flutter in the pivotal study, three (3) subjects had a total of three (3) serious adverse events within 30 days after a study procedure, none of which was device- or procedure-related.

Overall, the safety results of the pivotal study demonstrated that the risk of major complications associated with the use of the study device for left atrial ablation or CTI ablation was low. The frequency, severity and type of procedural complications reported in the study were in line with the published literature of RF catheter ablation of paroxysmal AF and typical atrial flutter.

C. Benefit-Risk Determination

The probable benefits of the device are also based on data collected in a clinical study conducted to support PMA approval as described above. Benefits include reducing atrial tachyarrhythmia recurrence in patients with symptomatic drug refractory paroxysmal AF and freedom from atrial tachyarrhythmia recurrence. Patients with typical atrial flutter derive benefit from being free of arrhythmia recurrence (e.g., symptom relief, quality of life improvement, obviating the need for long term antiarrhythmic medications, avoiding potential development of tachycardia-mediated cardiomyopathy, etc.).

The probable risks of the device are also based on data collected in a clinical study conducted to support PMA approval as described above. The risk of major complications associated with the use of study device for left atrial ablation and CTI ablation was low. Risks include esophageal injury, procedure related risks and arrhythmia recurrence.

1. Patient Perspective

   This submission either did not include specific information on patient perspectives or the information did not serve as part of the basis of the decision to approve or deny the PMA for this device.

In conclusion, given the available information above, the data support that for the treatment of type I atrial flutter and drug-refractory, recurrent, symptomatic paroxysmal atrial fibrillation, the probable benefits outweigh the probable risks.

D. Overall Conclusions

The data in this application support the reasonable assurance of safety and effectiveness of this device when used in accordance with the indications for use.

XIV. CDRH DECISION

CDRH issued an approval order on November 23, 2022. The final clinical conditions of approval cited in the approval order are described below.

The QDOT MICRO™ System PAS is a prospective, non-randomized, single-arm, observational, multi-center study to evaluate the chronic effectiveness and safety of the QDOT MICRO™ System for the treatment of symptomatic drug refractory paroxysmal atrial fibrillation. A total of up to 250 patients aged 18 years or older

will be enrolled over an enrollment period of 18-24 months with at least 50% of enrollment in the United States. Follow up clinical data will be collected at 3 months and/or 6 months (per hospitals' standard of care (SOC)), 12 months, 24 months and 36 months. The primary objectives will be:

1. Estimate the 12-month freedom from atrial fibrillation (AF) recurrence and 12-month freedom from atrial fibrillation (AF)/atrial flutter (AFL)/atrial tachycardia (AT) recurrence using the QDOT MICRO™ System; and

2. Estimate the serious device or serious procedure related adverse events for catheter ablation using the QDOT MICRO™ System through 12 months.

The secondary objectives will obtain additional data for the QDOT MICRO™ System as follows:

1. Estimate the 24 and 36-month freedom from AF/AFL/AT recurrence using the QDOT MICRO™ System;

2. Estimate the major complication rate in patients of 65 years of age or older;

3. Estimate the probability of achieving bidirectional block in the cavo-tricuspid isthmus (CTI) in patients who received concomitant CTI ablation using the QDOT MICRO™ System during the AF ablation procedure;

4. Estimate the major complication rate in patients who received concomitant CTI ablation using the QDOT MICRO™ System during the AF ablation procedure;

5. Estimate the rate of device malfunctions and their impact on safety and procedural delay

You are required to submit a progress report every six months for this PAS during the first two years, and annually thereafter.

The applicant's manufacturing facilities have been inspected and found to be in compliance with the device Quality System (QS) regulation (21 CFR 820).

XV. APPROVAL SPECIFICATIONS

Directions for use: See device labeling.

Hazards to Health from Use of the Device: See Indications, Contraindications, Warnings, Precautions, and Adverse Events in the device labeling.

Post-approval Requirements and Restrictions: See approval order.

XVI. REFERENCES

Calkins H et al. 2017 HRS/EHRA/ECAS/APHRS/SOLAECE expert consensus statement on catheter and surgical ablation of atrial fibrillation. *Heart Rhythm*. 2017; 14(10), e275-e444.

Dorian P et al. Interpreting changes in quality of life in atrial fibrillation: how much change is meaningful? *American Heart Journal, 166(2)*, 381-387.

Hao SC et al. Acute safety outcomes in younger and older patients with AF treated with catheter ablation. *J Interv Card Electrophysiol.* 2012; 35: 173-182.

Reddy V et al. Pulmonary vein isolation with very high power, short duration, temperature-controlled lesions. *JACC EP* 2019; 5: 778-786.

Zado E et al. Long-term clinical efficacy and risk of catheter ablation in the elderly. *J Cardiovasc Electrophysiol.* 2008; 19: 621-626.