SENSORS FOR MINIMALLY INVASIVE APPLICATIONS

HEART ARRHYTHMIA

EMPOWERING MINIMALLY INVASIVE EXCELLENCE: OUR SENSORS, YOUR ADVANTAGE

MINIMALLY INVASIVE PROCEDURES

Minimally invasive procedures have transformed modern medicine by offering alternatives to traditional surgery with smaller incisions, specialized instruments, and advanced technology. These procedures are gaining widespread adoption as they may allow for shorter recovery times, reduced risks, and better patient outcomes.

However, they come with challenges like the need for specialized training and advanced sensors technology to provide real-time feedback on key physiological parameters such as pressure, temperature, and force. This feedback is crucial for healthcare providers that are using minimally invasive technology to navigate delicate tissues and ensure precision. Minimally invasive procedures have been used to treat various conditions including cardiovascular diseases, gastrointestinal disorders, and orthopedic issues. For example, heart arrhythmia, a common cardiac rhythm disorder, has been effectively treated with minimally invasive techniques, reducing the need for open-heart surgery.

HEART ARRHYTHMIA

Heart Arrhythmia is a condition characterized by irregular electrical activity in the heart, leading to abnormal heart rhythms. These irregularities can result in a heartbeat that is too fast (tachycardia), too slow (bradycardia), or irregular. The first step in diagnosing an arrhythmia is a physical examination with a healthcare provider. Subsequently tests such electrocardiograms (ECG), MRI's, or echocardiograms can be used to confirm the arrhythmia. If the condition is determined to be treatable by cardiac ablation, various technologies and tools, such as transseptal needles, cardiac mapping, and radiofrequency ablation (RF ablation) and/or pulsed field ablation (PF ablation), can be utilized to address the arrhythmia.

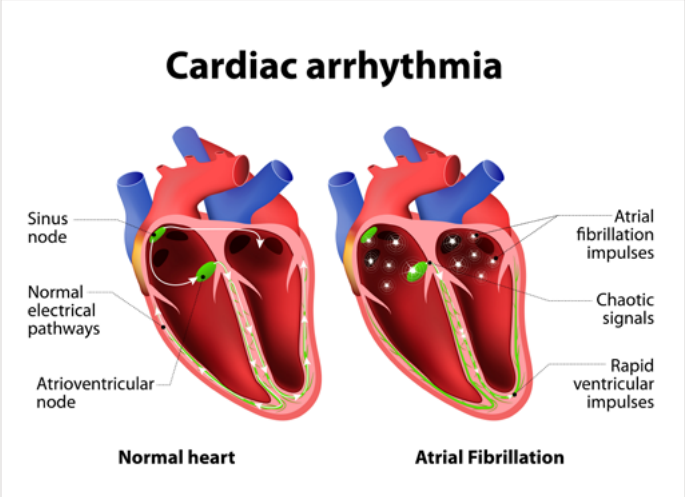
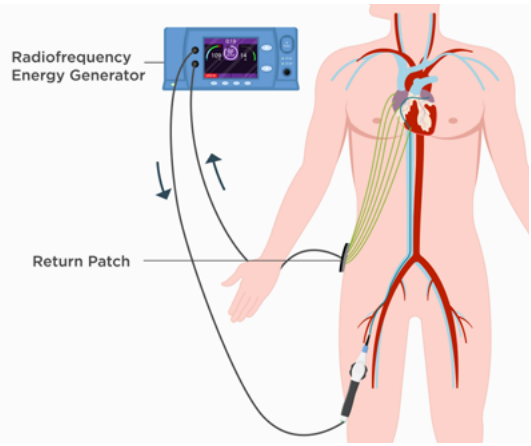


Figure 1: Comparison of Cardiac Electrical Activity in a Normal Heart vs. Atrial Fibrillation

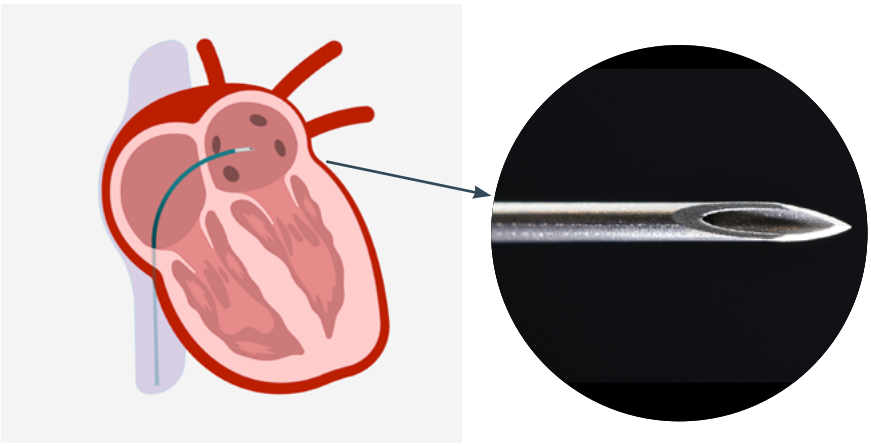
Figure 2: Comparison of Pulse Patterns in Normal Heartbeat, Arrhythmia, and Ischemia

TRANSSEPTAL NEEDLE APPLICATION

Ablation catheters are typically fed through a blood vessel in the right thigh near the groin. If the atrial fibrillation is occurring in the left upper chamber of the heart— it is standard practice to pierce the inner wall to provide a path for the mapping catheter and subsequent ablation catheter. A transseptal needle may be used for this purpose.



Insert catheter blood vessel



Feed into heart / puncture inner wall

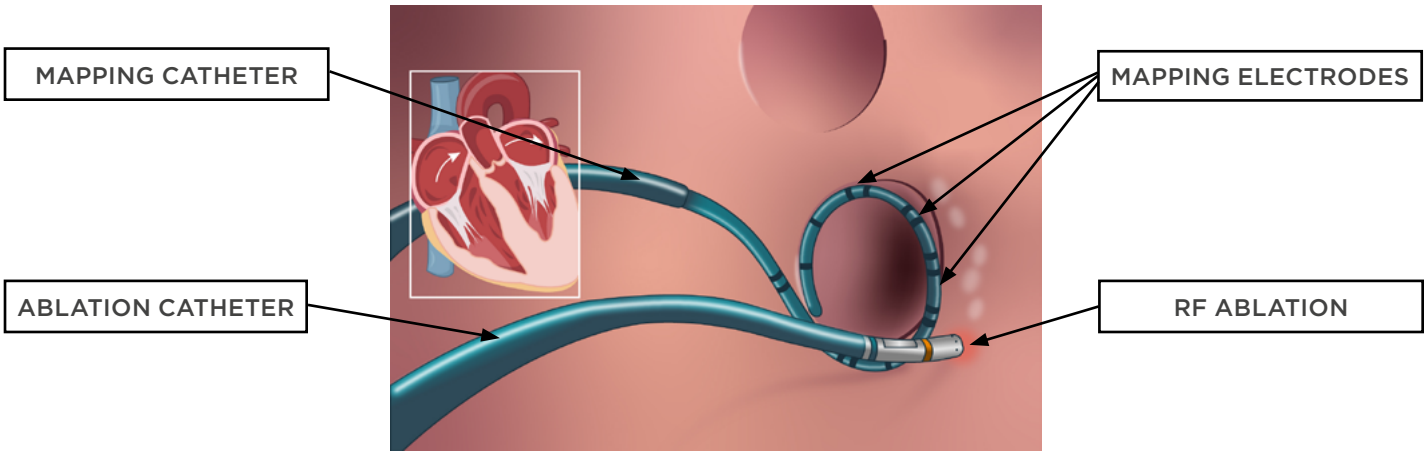
By integrating a pressure sensor within the transseptal needle, surgeons can be informed immediately when the needle enters the left chamber.

Sensor	Application	Key Product Features	Why Choose This Sensor?
IntraSense (pressure) 	Transseptal Needle*	• 1 Fr compatible • Calibrated option • Covers dynamic range of blood pressure • Digital Output	IntraSense can be assembled within a transseptal needle

* TE can partner with you to design sensors to be used in the transseptal needle application.

CARDIAC MAPPING APPLICATION

A key step in treatment is mapping to determine the location of the irregular heartbeat. A mapping catheter has an array of electrodes which records the electrical activity of the heart. Locations where the electrical activity is irregular are identified for ablation. The mapping also minimizes the area of the ablation. There are multiple geometries for mapping catheters. One of the original formats is shown below. Other types are configured in a matrix array.



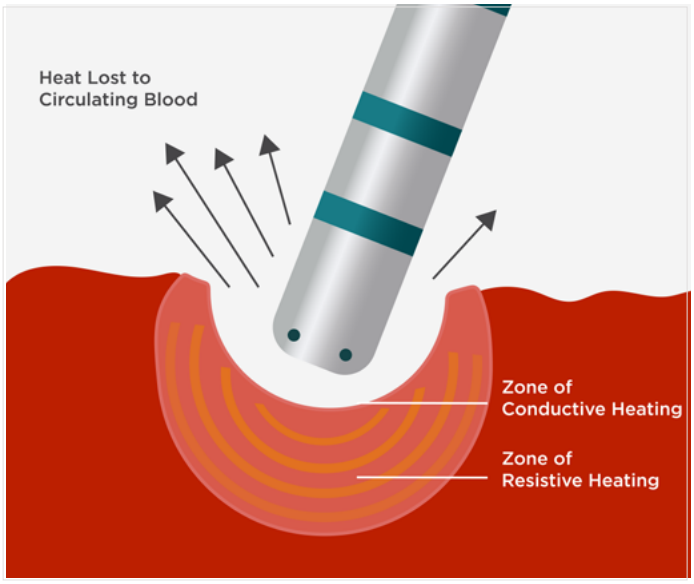
A potential application is using a force contact solution to ensure the electrode is in contact with the heart wall.

Sensor	Application	Key Product Features	Why Choose This Sensor?
IntraSense (Contact Force) 	Cardiac Mapping*	1 Fr compatible	Catheter pressure sensors have been used as contact sensors in esophageal manometry for over 15 years. 1Fr size facilitates the incorporate of multiple sensors.

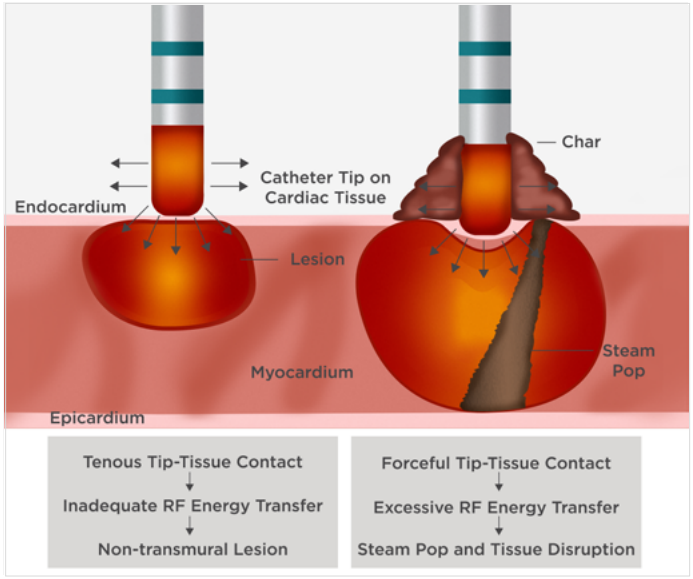
*TE can partner with you to design sensors to be used in the cardiac mapping application.

RADIOFREQUENCY ABLATION (RF ABLATION) APPLICATION

Atrial fibrillation is an irregular and often rapid heart rate that can increase your risk of stroke, heart failure and other heart-related complications. Ablation is used to deaden the tissue causing the fibrillation. The deaden tissue is referred to as a lesion.

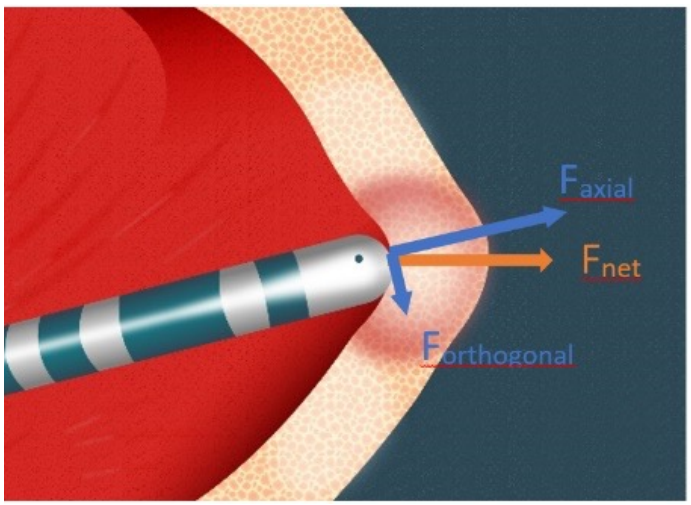


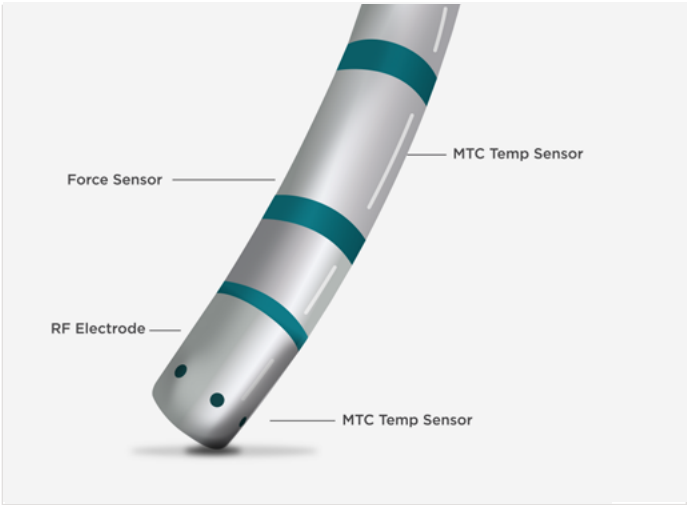
RF Ablation Heating



Ablation failure modes

Lesion formation can be optimized by measuring and controlling both force and temperature. This consistency enables characterization and optimization. Temperature is typically measured in multiple places. As the orientation of the catheter relative to the heart wall can vary, multiple temperature sensors can be placed in the ablation electrode. There may also be a temperature sensor placed away from the electrode. This measurement provides a characterization of the temperature gradient. This information can help to manage and control the ablation process, potentially reducing the risk of heat damage to adjacent tissue and blood.





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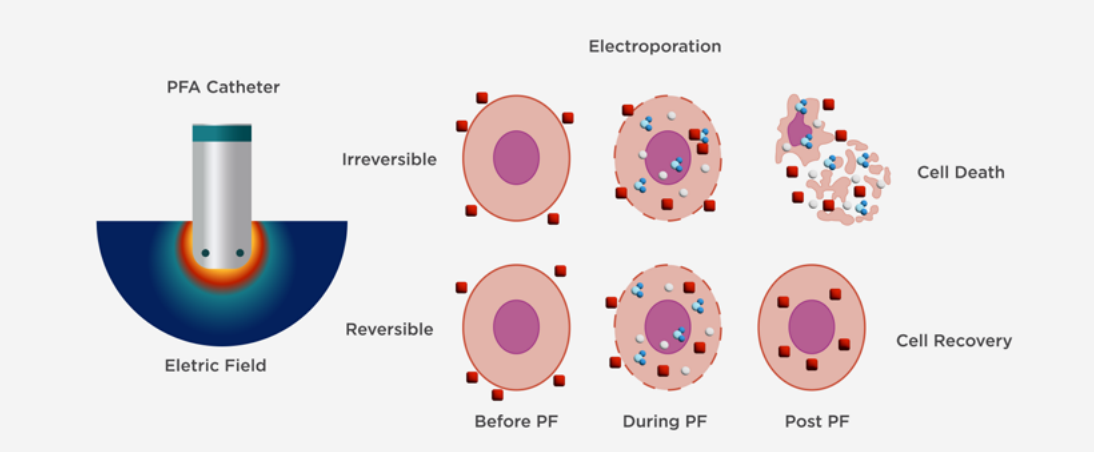
Sensor	Application*	Key Product Features	Why Choose This Sensor?
Micro-Thermocouple 	• Catheters - core body temperature • Ablation catheters • Cryotherapy • Tissue Shrinkage	• 40 and 44 AWG wire gauges • Moisture seal encapsulated junction • Type T and K	• Very small for space constraint applications • Custom packaging • High volume, low cost
Force	Please contact TE to discuss force sensor options.		

*TE can partner with you to design sensors to be used in the listed applications.

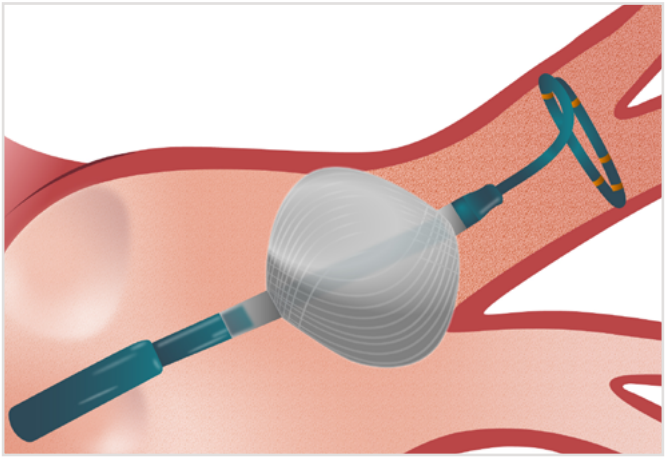
PULSED FIELD ABLATION (PF ABLATION) / DUAL ENERGY

Pulsed field ablation (PFA) is a new ablation technology that uses high voltage and very short duration pulses to kill cells.



CRYO ABLATION

Cardiac cryo ablation typically uses a balloon catheter for the procedure. Cryo ablation works by freezing cells thereby destroying their cellular structure. Similar to RF, the ablation procedure requires contact with the heart tissue and therefore is dependent on geometrical interface between the balloon and the heart. Cryoballoons are designed to provide a one-shot circumferential ablation.



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Cryo ablation catheters are inflated and positioned to freeze targeted cells. From a sensor perspective, a thermocouple sensor can measure the temperature of the balloon while a pressure sensor can measure the inflation pressure. In addition, monitoring the pressure can aid in the detection of leaks. Force sensors are not currently used on cryoballoons—most likely due to the limited space. A smaller force sensor that could be used on cryoballoons may enable incorporation of contact force sensing – providing confirmation of contact between the balloon and heart wall.

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Micro-Thermocouple 	• Catheters - core body temperature • Ablation catheters • Cryotherapy • Tissue Shrinkage	• 40 and 44 AWG wire gauges • Moisture seal encapsulated junction • Type T and K	• Very small for space constraint applications • Custom packaging • High volume, low cost
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Have a unique challenge? We have you covered.

At TE, we understand the critical role of advanced sensor technology in designing innovative, minimally invasive medical devices. Our seasoned technical experts are only a click away. Click 'Connect with an Expert' to schedule a meeting. Access an invaluable reservoir of knowledge and experience and let us help you make the most informed decision for your project. Together, let's redefine the future of minimally invasive procedures.

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Click here to chat with a Product Specialist.

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