

## Ensuring Successful Lead Impedance Measurements in Boston Scientific Pacemakers

### SUMMARY

Non-invasive measurement of lead impedance is an important diagnostic tool for verifying the integrity of pacing leads. Each device automatically stores daily impedance measurements, which can be used to monitor lead integrity over time. In addition, commanded non-invasive lead impedance tests allow for instant evaluation of system integrity in a clinic setting.

This article outlines various temporary programming options that can be considered in order to ensure pacing and a successful lead impedance test.

### CRM PRODUCTS REFERENCED

The following are trademarks of Cardiac Pacemakers, Inc., a Boston Scientific company: ALTRUA, INSIGNIA, PDM: PULSAR/PULSAR MAX/DISCOVERY/MERIDIAN, PDII: PULSAR MAX II/DISCOVERY II

Products referenced herein may not be approved in all geographies. For comprehensive information on device operation, reference the appropriate product labeling.

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Device circuitry performs lead impedance measurements by measuring pacer spike decay and calculating impedance based on the amplitude and pulse width of the specified test pulse. Therefore, the device **must pace** in order to calculate and store a lead impedance measurement.

### Manual / Commanded Lead Impedance Measurements

Listed below are the most common reasons why a pacemaker may not deliver a pacing pulse and therefore fail to provide a successful atrial and/or ventricular lead impedance measurement:

- The patient's intrinsic rate is faster than the programmed Lower Rate Limit in the chamber being tested.
- The patient's intrinsic rate is faster than the Maximum Tracking Rate (i.e., devices will not pace beyond this rate).
- Pacing is not enabled in the chamber for which an impedance value is desired (e.g., device programmed to AAI will not pace in the ventricle)
- In DDD(R) mode, if the pacemaker has ATR mode switched to a non-atrial pacing mode (e.g., VDI) due to an atrial arrhythmia, pacing will not be delivered in the atrium.
- If the Atrial Flutter Response feature is programmed On and is active during an atrial flutter, pacing will not be delivered in the atrium.

### How to Obtain a Successful Lead Impedance Measurement

To ensure the device delivers a pacing pulse during manual/commanded lead impedance tests, clinicians may consider the following **temporary** programming options, as appropriate for each patient:

- Increase the Lower Rate Limit above the patient's intrinsic rhythm.
- Decrease the AV Delay to increase the chance that a ventricular pace occurs prior to an intrinsic/conducted ventricular contraction.
- Program the device to an asynchronous mode (e.g., DOO, AOO or VOO).
- Program the device to a single-chamber inhibited mode (e.g., AAI or VVI) or triggered mode (e.g. AAT or VVT).

### Automatic Switching to Triggered Mode

To help ensure pacing in the chamber being tested, PDII, INSIGNIA®, and ALTRUA® devices temporarily switch to a triggered mode, which delivers a pacer spike into a sensed event. However, even in triggered mode, any of the following situations may prevent the device from pacing:

- The patient's intrinsic beat is classified as a PVC
- The patient's intrinsic beat falls into a refractory period
- The patient's intrinsic rhythm is faster than the Maximum Tracking Rate

If any of these situations preclude the device from triggered pacing during a commanded lead impedance test, a 'pop-up' message will appear on the programmer screen (Figure 1). In these rare cases, clinicians should again consider other temporary programming options to ensure pacing in the chamber being tested.

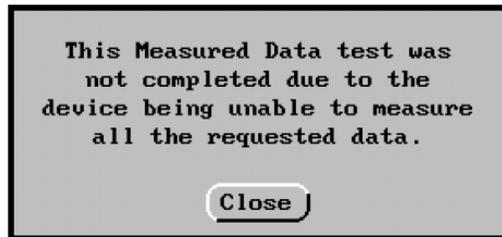


Figure 1. Programmer screen message indicating unsuccessful measurement.

### Automatic Daily Lead Impedance Measurements

Once each day, Boston Scientific pacemakers will automatically attempt to measure lead impedance for each cardiac chamber in which pacing is enabled. If a lead impedance measurement is unsuccessful due to the lack of pacing, the pacemaker will repeat the measurement. If the measurement cannot be obtained in the allotted time period, no data is stored for that day. The device will not repeat the measurement attempt until the following day.

An unsuccessful daily lead impedance measurement is displayed on the programmer screen as "SENSED" (Figure 2) or "N.R." (Figure 3).

Daily Measurement		
Date	Atrial	
	Amplitude (mV)	Impedance (Ω)
25-JAN-2007	1.1	200
24-JAN-2007	1.0	SENSED
23-JAN-2007	1.0	200
22-JAN-2007	0.6	SENSED

Figure 2. No measurement obtained in PDM pacemakers.

Atrial		
Date	Amplitude	Impedance
	(mV)	(Ω)
28-JAN-2007	1.1	200
27-JAN-2007	1.0	N.R.
26-JAN-2007	1.0	200
25-JAN-2007	0.6	N.R.

Figure 3. No measurement obtained for PDII, INSIGNIA®, or ALTRUA® pacemakers.

**NOTE:** ALTRUA, INSIGNIA, and PDII pacemakers automatically initiate daily lead impedance measurements upon detection of an attached lead and removal from Ship mode. Since lead detection also requires pacing, it is possible that the start of daily measurements (including lead impedance) can be delayed due to one or more of the reasons listed above.