Cross-Chamber Blanking Periods in ICDs and CRT-Ds

BACKGROUND

Definition of terms used in this article:

Refractory period: an interval following a sensed or paced event, in which the system is unresponsive to sensed input.

Cross-chamber blanking period: a type of refractory period; an interval following a sensed or paced event, in which the system is unresponsive to sensed input from another chamber.

Cross-talk / far-field sensing: the sensing of events from one chamber in another chamber (e.g., inappropriately detecting an atrial paced event in the ventricular chamber).

ICD: Implantable Cardioverter Defibrillator
CRT-D: Cardiac Resynchronization Therapy Defibrillator

CRM PRODUCTS REFERENCED*
All Boston Scientific ICDs and CRT-Ds

*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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Introduction

Cross-chamber blanking periods are an integral part of the ICD and CRT-D sensing systems. They are used to suppress detection of device-generated artifact (e.g., pace or shock delivery) as well as certain intrinsic signal artifacts (e.g., far-field R-waves).

- Events that occur during refractory and cross-chamber blanking periods are ignored for the purposes of pacing timing cycles and ventricular tachycardia detection.
- Each refractory and fixed cross-chamber blanking period includes a re-triggerable noise window, which helps to detect and classify persistent noise.

Cross-chamber Blanking Periods

Cross-chamber blanking periods are designed to promote appropriate sensing of in-chamber events and prevent oversensing of activity in another chamber (cross-talk / far-field sensing). Cross-chamber blanking periods are initiated by paced and/or sensed events in an adjacent chamber. For example, a blanking period is initiated in the right ventricle (RV) each time a pacing pulse is issued in the atrium to avoid detection of the atrial paced event in the RV chamber. Blanking periods are programmable and are described in Figure 1.

	Parameter	Description	Key
ICDs & CRT-Ds	A-Blank after V-Pace	Inhibits atrial sensing following a ventricular paced event	
ICDs	A-Blank after V-Sense	Inhibits atrial sensing following a ventricular sensed event	
	V-Blank after A-Pace	Inhibits ventricular sensing following an atrial paced event	
CRT-Ds	A-Blank after RV-Sense	Inhibits atrial sensing following an RV sensed event	
	RV-Blank after A-Pace	Inhibits RV sensing following an atrial paced event	
	LV-Blank after A-Pace	Inhibits LV sensing following an atrial paced event	

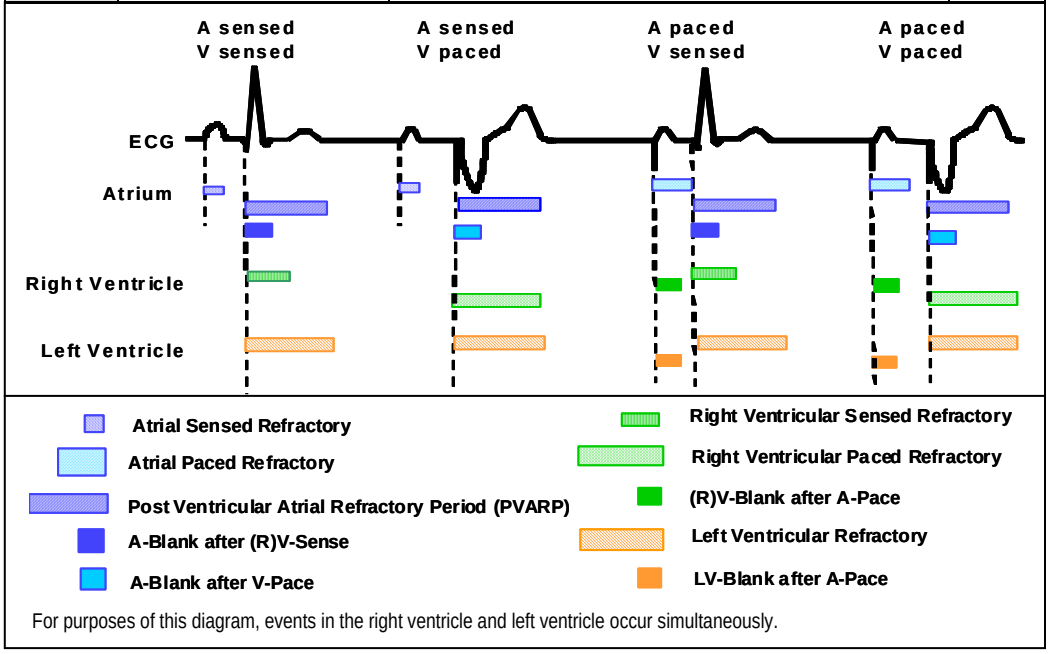

Figure 1. CRT-D refractory and cross-chamber blanking periods.

Programming Cross-Chamber Blanking Periods

Two types of blanking parameters (fixed values or Smart blanking) are available to prevent oversensing events from adjacent chambers:

1. **Fixed values** (e.g., 45 ms, 65 ms, 85 ms, 105 ms, 125 ms)
   Programmable fixed values vary by product family and by the specific type of blanking period within each product family.

   Shorter fixed values offer:
   - Less potential for undersensing in-chamber intrinsic events
   - Greater potential for oversensing cross-chamber artifacts

   Longer fixed values offer:
   - Greater potential for undersensing in-chamber intrinsic events
   - Less potential for oversensing cross-chamber artifacts

2. **Smart blanking** (when available)
   Smart blanking combines a shorter refractory period (37.5 ms following paced events and 15 ms following sensed events) to reduce undersensing of in-chamber events with an automatic adjustment of the sensitivity to reduce the possibility of detecting cross-chamber artifacts (Figure 2).

   NOTES:
   - *Smart blanking is available for all programmable cross-chamber blanking periods in COGNIS and TELIGEN devices and for the **A-Blank after V-Sense** blanking period in VITALITY 2 and VITALITY AVT devices.*
   - *Sensitivity adjustments associated with Smart blanking may not be sufficient to inhibit detection of cross-chamber artifacts if the cross-chamber artifacts are too large. Consider other factors that impact the size/amplitude of cross-chamber artifacts including lead-placement, pacing output, shock output, and time since last delivered shock.*

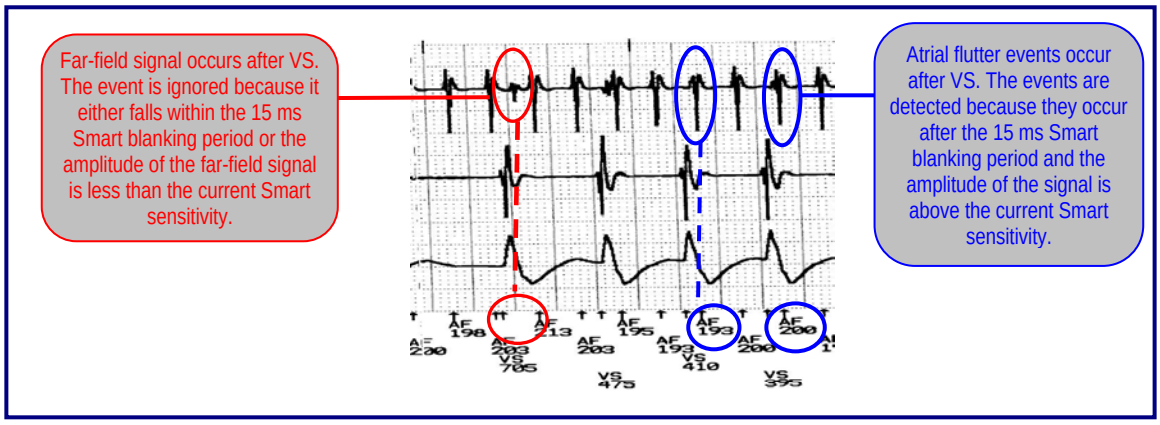

Figure 2. Example of Smart blanking: A-Blank after V-Sense.

Patient Considerations

As with all device programming, individual patient needs should be considered when programming cross-chamber blanking periods. For example, when programming the **RV-Blank after A-Pace** cross-chamber blanking period, consider the tradeoff between ventricular oversensing of atrial paced events ***and*** ventricular undersensing of PVCs:

- If **RV-Blank after A-Pace** is programmed to a fixed value:
  - **Longer fixed value**—lessens the potential for oversensing of artifact from the atrial paced event, but increases the potential for undersensing R-waves (PVCs).
  - **Shorter fixed value**—lessens the potential for undersensing of R-waves (PVCs), but increases the potential for oversensing of artifact from the atrial paced event.
- If **RV-Blank after A-Pace** is programmed to Smart blanking, the device will automatically adjust ventricular sensitivity in an effort to disregard far-field atrial events, while the shorter blanking window will promote sensing of in-chamber ventricular events that might otherwise be hidden by a longer blanking period.
  - If Smart blanking is used, consider testing in-clinic for proper sensing after shock delivery, especially if the patient is pacemaker-dependent. If oversensing is occurring post shock delivery, be prepared to use the STAT PACE command.

To promote continuous pacing for **pacemaker dependent patients,** it may be preferable to lessen the potential for ventricular oversensing of atrial paced events by programming a longer blanking period, even though the likelihood of undersensing a PVC may increase (should it occur within the RV-Blank after A-Pace cross-chamber blanking period).

For **patients with sick sinus syndrome and frequent PVCs who are not pacemaker dependent,** it may be preferable to shorten the blanking period to lessen the potential for undersensing a PVC (should it occur simultaneous with an atrial paced event), even though the likelihood for ventricular oversensing of an atrial paced event may increase.

Post-Therapy System Response

Residual energy on the defibrillation lead after shock delivery can increase the likelihood of cross-talk / far-field sensing. As this residual energy dissipates with time after shock delivery, the potential for cross-talk / far-field sensing also decreases. To reduce oversensing after shock delivery, a longer fixed value is automatically applied for all cross-chamber blanking periods during the Post-Therapy Period (nominally 30 seconds). See Figure 3 for an example.

- If the cross-chamber blanking period is programmed to a fixed value of 85 ms or less, or to Smart blanking, then an 85 ms blanking period will be used during the Post-Therapy Period.
- If the cross-chamber blanking period is programmed to a fixed value longer than 85 ms, the longer value will be used during the Post-Therapy Period.

NOTE: *Once the Post-Therapy Period expires, all cross-chamber blanking parameters revert back to their permanently programmed values.*

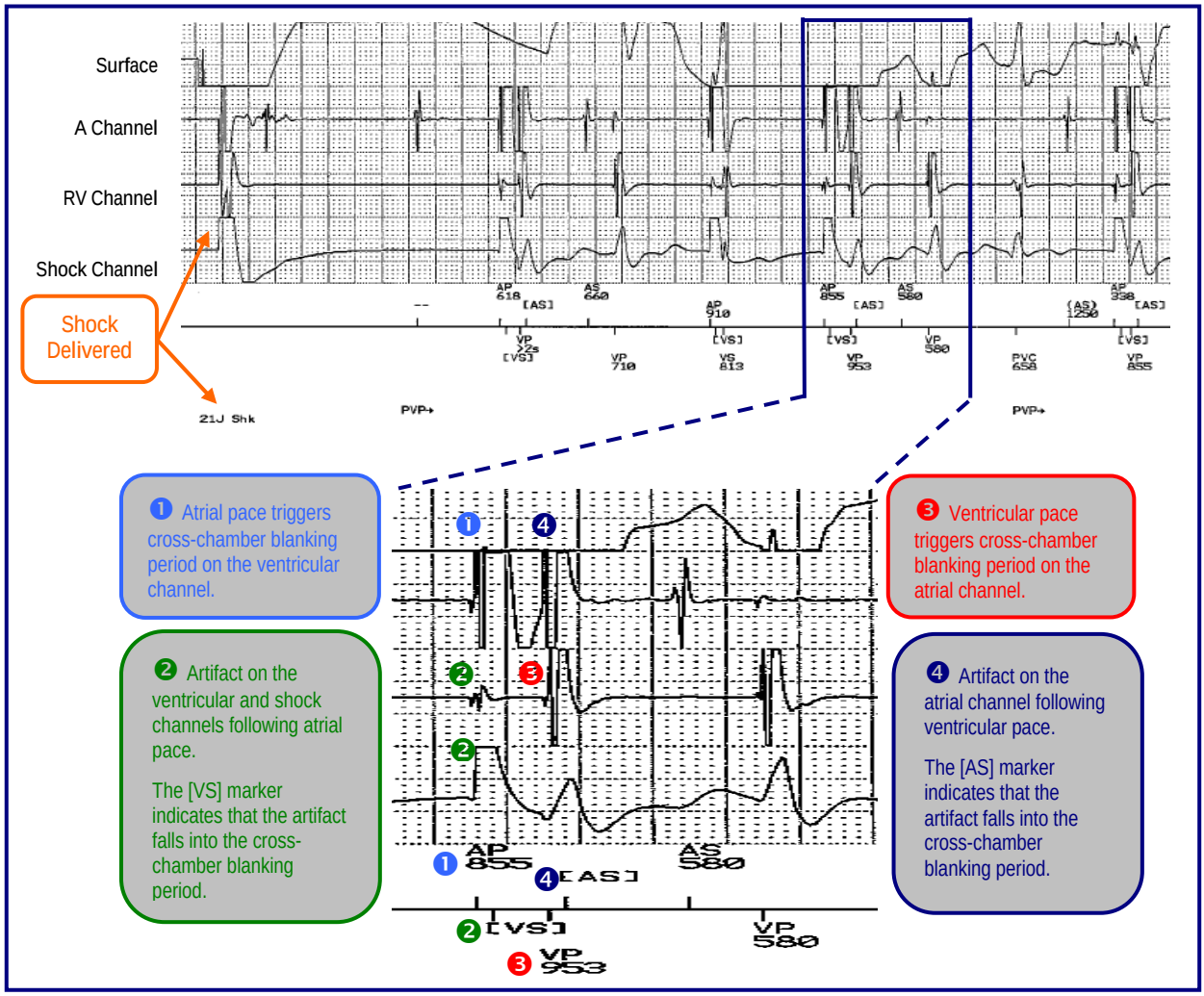

Figure 3. Example of device behavior during the Post-Therapy Period.