SmartCrane™ Anti-Sway Crane Control

Operator Guide
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About This Guide

This document provides description and operator instructions the SmartCrane™ Anti-sway Control for overhead traveling cranes, rail mounted gantry cranes, and other cranes whose lift point height remains constant.

SmartCrane® Anti-sway is computer-controlled operation of the trolley speed, gantry speed, and hoist speed for the purpose of decreasing the time required to move a suspended load between destinations and improving the safety of operations. The SmartCrane® software runs on a computer that shares or can exchange data with the customer’s crane drive in real time and responds, through the drive or directly, to operator’s commands. The patented SmartCrane™ Anti-sway Control uses an open-loop algorithm that eliminates load sway induced by trolley accelerations and decelerations. It operates in three modes: Manual Anti-sway, Automatic Move, and Suspend. In Manual mode, the control responds to the operator's trolley stick demands and completely inhibits sway no matter what demands the operator gives.

In This Guide

This operator guide includes the following information:

- Chapter 1, “How Anti-sway Works” explains the basic principles of anti-sway, including the use of an optional camera and typical modes of operation.
- Chapter 2, “Using Manual Anti-Sway” tells how the operator should adjust control techniques when using SmartCrane anti-sway “under the stick,” including tips for moving loads a short distance.
- Chapter 3, “Using Automatic Moves” explains how an operator can save and select destinations, and start and stop automatic moves.
- Chapter 4, “Understanding the Touch Panel” describes the different versions and sections of the SmartCrane touch screen user interface.
- Chapter 5, “Special Features” describes optional features that may be installed in your system. Consult your administrator if you’re not sure about these features.
Other SmartCrane documents may be useful to operators, installers, PLC programmers, and maintenance personnel. These documents are in pdf format and are available for download free of charge from http://www.smartcrane.com/documents.

PLC Interface Specifications

This manual describes detailed data interfaces required to allow the anti-sway software to work with a crane’s PLC to control sway during both manual and automatic moves. Two configurations are addressed, where the primary operator interface is provided either by the PLC or by the SmartCrane™ touch screen.

Operator Quick Guide

This two-page document contains short descriptions of operator use of the SmartCrane touch panel, using mostly picture rather than words.

Initialization Manual

This manual describes the details of the SmartCrane™ Initialization File. This file allows the same basic software product to be installed for different crane classes, crane types, lifting mechanisms, and crane response characteristics.

Installation and Maintenance Manual

This document describes the steps to install a SmartCrane system under various installation options. It also provides critical data for maintenance personnel to diagnose and correct problems, and how a customer can set up remote access to equipment and receive SmartCrane support.
How Anti-Sway Works

Read this chapter to understand how the SmartCrane Anti-sway controls the motor speeds to guarantee no sway at the end of a move.

When an operator moves the control stick to a certain speed, the SmartCrane™ Anti-sway Control accelerates initially according to the operator’s demand, inducing an initial load sway. When about half the reference velocity has been reached, the anti-sway "coasts", i.e., maintains constant velocity, for a short time. Then the trolley is accelerated again, this time to the full operator demand velocity. This second acceleration kills the sway induced by the first acceleration, so the trolley is now traveling at the operator reference velocity with the load hanging directly below the trolley. When the operator releases the stick, demanding zero velocity, the same process is repeated in reverse to bring the load to a stop without sway. If the operator demands movement for a short time, the anti-sway will bring the motion to a stop and then perform a second movement precisely timed to catch the sway.

The SmartCrane Anti-sway accounts for changes in hoist cable length, changes in operator demand, etc. The key feature is that the SmartCrane™ Anti-sway Control relies on precise timing of accelerations to control the sway. It does not require a camera or other sway sensing device to control sway induced by moving the crane.

In order to remove sway introduced by other factors such as wind and non-vertical lift, the SmartCrane™ system offers an optional SmartCamera™ system that measures and corrects for actual sway in real time, usually at the end of a move once the trolley has come to a stop.

What the Anti-sway Needs from the Crane

For manual anti-sway operation, the SmartCrane™ system only requires measurement of hang length and lift load. In order to perform automatic moves, the system also needs trolley and gantry positions.

Anti-sway will not operate if these four measurements are not present (and properly “homed” if necessary).
When a sway sensor camera is installed

With a SmartCamera™ installation, a camera and computer combination mounted in the trolley tracks the location of a special target on the top of the spreader. With these measurements, the Anti-sway Control can determine whether any excess sway has been induced by external factors. The feedback data is used at the end of manual and automatic moves. In an automatic move it also adjusts the position of the spreader to the exact destination position.

Modes of operation

In Automatic Move mode, the trolley is moved automatically to a predetermined position in response to a button press or command from a remote control. The operator can press a different button during the move, or he can interrupt the move by simply moving the joystick in the desired direction of travel. Transition from one mode to another, or from one destination to another, is seamless.

In Suspend mode, the control carries out no anti-sway operations, but waits for new commands from the drive control.

Typically, the operator has a switch that selects modes. In position 0, anti-sway is OFF (suspend mode). In switch position 1, both Manual Anti-sway and Automatic Move are available. In position 2, Automatic move is available but when an automatic move is not in progress, anti-sway is suspended.
Using Manual Anti-Sway

Read this chapter to understand how to use the SmartCrane Anti-sway effectively in manual operation.

Manual Operation is the basic control mode, requiring only a few adjustments in the operator’s routine.

Selecting full anti-sway operation

To use the manual anti-sway method, move the anti-sway switch to the left to select Full Anti-sway.

If the system is operating correctly, the light on the switch will come on. If it does not light, check the display on the SmartCrane touch screen (see Chapter 4 for details). Contact a maintenance person if the normal corrective action does not solve the problem.

How to control the crane with the joystick during full anti-sway operation

Control of crane and trolley motion is the same as with regular manual control, except that full stick can be used at any time. When stopping, simply return the stick to the zero position and wait for the crane to stop smoothly and safely.
Because the anti-sway inserts one or more hesitations in the slowing process, it will take just a little longer to come to a stop, and the crane and trolley will travel a bit longer before stopping. This means that the operator will need to begin slowing or just release the stick a little earlier than usual. Depending on the operator’s personal approach, he may either try to judge the stopping distance and use zero speed, or begin slowing down in order to reach the final destination. Some practice will be required.

Making small adjustments using anti-sway

When moving a short distance (less than 1 meter), the operator should use the stick to move the trolley just a part of the distance needed and let the anti-sway make the rest of the move. In the trolley direction, the anti-sway will add almost exactly as much motion as the operator, so moving half the desired distance works perfectly. Looking up at the trolley itself (instead of the spreader) during this short move will produce an accurate move.

In the crane or gantry direction, the crane’s reaction time is slower and the anti-sway will usually add almost twice the distance moved by an operator’s first motion, so moving the gantry about one-third the desired distance will achieve the correct result after the anti-sway response. Again, it is more useful to watch the gantry wheels or crane leg compared to background reference helps the operator judge these small motions.
What to do if some sway occurs anyway

If the load is not lifted straight, or if it comes in contact with other loads, some extraordinary swing can sometimes occur. A skilled operator should simply turn anti-sway off momentarily and adjust the controls to stop the swinging, then turn anti-sway back on.

Open loop anti-sway (without camera) cannot detect these extraordinary swings but will actually preserve any existing swing through a complete move. If there is 1 meter of swing at the beginning of a move, there will still be 1 meter of swing at the end.

Using the closed loop camera system

If the crane is equipped with a SmartCrane™ smart camera and reflector, the camera will track the movement of the spreader in real time. Then the anti-sway may use that information to make small adjustments to remove any remaining sway. The camera will react only if the amount of swing exceeds some maximum distance, depending on the settings at each installation. So in most moves, the camera corrections may not be needed at all or may be so small as to be unnoticeable.

The operator should have a switch to turn the camera on and off as needed. Normally no action is required if the camera is left on all the time. During dark periods, a special light mounted near the camera is used to illuminate the reflector. This light should be on all the time, except it may be turned off on bright sunny days.

The installation may include both the light and the camera on the same switch, in which case the light must always be on when the camera is in use.

If the camera is on but does not seem to react, the operator may turn the camera off then on again to restore the proper functioning.
Using Automatic Moves

Read this chapter to understand how to use the SmartCrane automatic move feature.

Automatic operation assists the operator by moving the crane and trolley to the desired destination, completely automatically, and without residual sway at the end. The moves are accurate enough to allow most operations such as setting hooks or tongs without further operator adjustments.

Selecting full or automatic anti-sway operation

To use the automatic anti-sway method, move the anti-sway switch either to the left to select Full Anti-sway or to the right to select automatic moves only.

If the system is operating correctly, the light on the switch will come on. If it does not, check the user screen.

In full anti-sway, both the manual functions from chapter 2 and the automatic functions described in this chapter will be in effect. In "auto moves only" the manual anti-sway features of chapter 2 are not in effect but the operator may still activate the automatic move features.

Using the touch screen controls

To use the automatic anti-sway method, the operator must be familiar with the elements of the touch screen control panel. This panel is described fully in Chapter 4. The windows of the screen are:
- A control view window showing an overhead or side view of the crane(s) and other parts of the crane’s yard area.

- Two alternate view windows showing the hoisting height and the objects in the vicinity of the crane.

- Control buttons that can activate pre-stored destinations.

- Activation buttons to start, stop, change the display, and logout.

- A digital data window, showing key real time data.

- A switchable display window, providing (1) 3D display, (2) PLC data display, (3) camera data display, and (4) graphical system display.

The touch screen window arrangement is depicted here:

The user can select automatic move destinations using the Control View or the destination buttons. The user can start and interrupt moves using the control buttons. A move can always be interrupted with a touch of the crane/trolley control stick.
How to choose a destination from the Control View window

To choose any arbitrary destination in the work area, simply touch the control view window anywhere in the permitted region.

If you touch an empty space, the yellow crosshairs will move to that position. If you touch a payload symbol (shipping container, furnace ladle, steel slab, steel coil, etc.) the symbol will briefly expand in acknowledgement and the crosshairs will move to the center of the payload. If you touch the crane trolley symbol, the crosshairs will move to the center of the trolley position.

To make small adjustments, the operator may touch at the extreme boundaries of the control view window. If boundaries have been entered for the crane motion limits, a red box appears on the control view and the cursor will not move outside its limits.

How to choose a saved destination using the buttons

To choose a saved destination in the work area, simply touch the corresponding labeled button. Only buttons that are labeled and are colored gold are available for use. Depending on the particular crane and other cranes that may be neighbors, some active buttons may not be available to your crane.

Some buttons may hold multiple destinations, depending on your installation. On the first press of one of these buttons, the crosshairs will move to the corresponding location in the control window. If you press the same button more than once, the buttons label and location will rotate among the clustered destinations.
Starting, stopping, and canceling automatic moves

If you select a valid location by touching a location or labeled button, the system will draw a red line from the present position of the trolley to the destination. The line may not be straight, in case of obstacles (see Chapter 5, “Special Features”) that might be in the way.

Once the line is drawn, you have 30 seconds to begin the automatic move. If you wait more than 30 seconds, the line will go away and you will have to select a destination again to continue. Press and hold the gold “GO” button until it turns green. Once you then release the button, the control window background changes from blue to green, and the move begins. At the same time the “STOP” button changes from grey to dark red.

If you decide not to proceed with the move after the GO button turns green but before you release the button, simply move your finger away from the GO button and the move will not start. Once a move has started you can stop it safely at any time, by touching the STOP button. You can also cancel an automatic move by moving the trolley/crane control stick from its stop position. In either case, the move will stop safely, without sway, no matter what operating mode you have selected.

If you select a destination that is not available for your crane, an alert window will pop up, telling you why. Some reasons are:

- The destination is out of range of your crane (see the red boundary on your control screen).
• The destination cannot be reached because of obstacles that your crane cannot move over or around.

• The destination would require your crane to approach too closely to another crane on the same rails.

When an automatic move is completed or canceled, the control window will turn blue again and after a short while the brakes will set.

Permanent and temporary destinations

An administrator may set some of the destination buttons to permanent locations. Instructions for creating or modifying these destinations and their symbols, as well as for implementing multiple-location buttons, can be found in SmartCrane Initialization Manual. Permanent locations can only be modified or removed by an administrator.

Temporary destination buttons are initially grey in color and blank (no labels). To create a new destination, move the crane to the precise position and then press and hold any of the temporary buttons until its color changes to green. If your installation has implemented its row/stack indexing system in the SmartCrane system, then the label of the button will change to agree with the closest row and stack. The new destination will also appear in the control window as a small cross with the same label.

To change an existing temporary destination button, use the same procedure and the label and position will change to the new destination. The anti-sway system preserves temporary locations after a restart.
How to control hoist during an automatic move

There are three methods of hoist control during an automatic move, depending on our installation. The operator and operator alone is responsible for prevent collisions in all cases. an administrator will select only one of these methods for use by all operators:

- Operator hoist control;
- Interruptible automatic hoist control; or
- Safe height hoist control.

Operator hoist control

In operator hoist control, the operator is in complete control of hoisting and thus must make sure the load is hoisted clear of objects in the field before the horizontal movement can cause a collision. If a high stack is nearby when lifting from a low stack, it will be necessary for the operator to hoist clear before starting the automatic move. Otherwise, hoisting and starting the move can be accomplished together.

Automatic hoist control

Automatic hoist control is only available in installations where (1) Objects are never stacked so high as to make hoisting to the same height every time impractical or (2) The inventory of objects in the field is available to the SmartCrane system. The SmartCrane system does not have access to the stack inventory unless one of these conditions applies:

- The crane is the only machine that moves objects in the stacks or
- Other cranes or machines in the same field update and share stack information either directly or through a server.

Under these conditions, the SmartCrane anti-sway system records every movement in the field in both horizontal and vertical directions. Then, when setting up an automatic move, it will plan a hoist profile that safely and efficiently clears all objects in the field. If there are obstructions in the field (see Chapter 5, “Special Features”), the automatic move planner may hoist over or go around obstructions, depending on load condition and obstruction height.
In an installation where objects are never stacked so high as to make hoisting to the same height every time impractical, an administrator will enter the maximum stack height once, and the SmartCrane move planner will use that used for all moves.

The operator can review the start and finish heights computed by the SmartCrane move planner by examining the alternative view windows, where horizontal lines labeled “START” and “FINISH” show these critical heights. The operator can change those heights before beginning a move, using the touch screen. The operator may make fine adjustments to the heights by touching at the top or bottom of each panel.

The red horizontal line represents the travel height. The SmartCrane control will hoist the load to that height before beginning any horizontal motion. The green horizontal line represents the finish height. The SmartCrane control will begin hoisting down near the end of the move but the load will not descend below that height until the trolley has arrived at the correct location.

For cranes that lift and deposit loads, the control will continue hoisting down until the load or clamp is at the bottom of travel as indicated by the load indication from the PLC. For other cranes, the control will not hoist below destination height.

At any time during an automatic move, the operator may take over control of the hoisting function by moving the hoist joystick. The SmartCrane automatic move will revert to operator control immediately and remain in that mode for the remainder of the move.

**Safe height hoist control**

In safe height hoist control, the operator is in complete control of hoisting but the SmartCrane automatic move delays the start of crane and trolley motion until the spreader has been hoisted above a specific height by the operator or by the PLC. If automatic hoist control were available under conditions shown above, the safe height is calculated automatically. Otherwise a standard safe start height is used as a default, but can be changed by the operator using the touch screen.
In the Quay Crane control version, safe height is established by default value or by operator control for the first move over a ship. Successive moves over the ship have safe heights calculated from known stack heights, based on container lifts or other sensors.

**Automatic load attachment and detachment**

If enabled for a crane installation, the SmartCrane system can automatically engage or disengage a load, for pickup or delivery. This feature is available for the following crane types. Check with your administrator or trainer to determine if and how these features are activated in your installation.

- On container cranes where “flippers” guide the spreader onto a container, the system can be set to engage a container automatically, given that the container’s position is known accurately. On container cranes where the delivered container does not need to mate to corner blocks, the system can be set to deposit the container at its destination.

- On steel mill ladle cranes, where two hooks are suspended beneath the spreader bar that will mate with two handles on the ladle, the SmartCrane system can be set to hook on and unhook automatically. This feature requires load cell readings from the PLC, so that the system can detect unsafe conditions in a split second (see chapter 5, “Special Features”). In order to accomplish safe hooking, the height of the ladle must be known to the system, either from a standard floor height at each destination, or from a previous placement of the same ladle.

- On slab cranes, where one or more slabs are lifted using two pairs of tongs, the system can be set to lower to a position where tongs can be closed and slabs lifted. The system can set slabs down automatically, however the system will not relieve all strain until the operator determines that the stacking is straight and level, or has taken corrective action manually. The operator will always be required to make the final hoist down manually, to release the tongs.

- On coil cranes with one pair of tongs, the system can be set to pick up or deliver coils automatically. The system will not attempt an automatic pickup of a coil where its precise position was not previously measured by itself or another precise positioning system.
Working With the Touch Screen

Read this chapter to understand how to use the SmartCrane touch screen to display useful information.

Automatic operation assists the operator by moving the crane and trolley to the desired destination, completely automatically, and without residual sway at the end. The moves are accurate enough to allow most operations such as setting hooks or tongs without further operator adjustments.

Identifying Loads

If the SmartCrane system is set to identify loads when lifted and moved, then every load in the field of operation will appear in the control window (and in the 3D window, if available). This feature is only available if the conditions for automatic inventory of Chapter 3 are satisfied.

Loads can have either numbers (up to 9 digits) or alphanumeric identifiers (up to 22 characters). An administrator will need to supply a starting load inventory that has the approximate row, stack, and height information for every item in the field.

Loads can have the following shapes:

- Box shape, for containers, slabs, and other rectangular loads;
- Vertical cylinder shape, for ladles; or
- Horizontal cylinder shape, for coils.

Load shapes may be mixed, however the current system does not support multiple hoist modes for a crane, so it is only practical to manage loads of the same shape and lifting mechanism (spreader, tongs, hooks).

The SmartCrane system retains load identifiers when they are moved from one location to another within the storage field. New loads entering the field will require some method of identification. By default, when the SmartCrane system lifts a new load from a location where no load was in the
inventory (such as a designated transfer zone) it assigns the load an unused identifying number and an alphanumeric identification created from the date and time it was first lifted.

Your installation may have a customized version of SmartCrane that can assign a different identification name or number; consult with your administrator to learn what operator action may be needed to accomplish this.

In a similar manner, when a departure zone is defined and the crane deposits a load there, the SmartCrane system deletes it from its local inventory and its symbol is erased.

In situations where the load inventory is stable (e.g., ladles in a metal mill), each one has a permanent identifier.

If the crane lifts a load from a position where there is no load symbol, the system will create a symbol and alert the operator. For a short time after the lift, the system permits the operator to select an existing load number by pressing the PAGE button. If the operator does not make a selection, the load remains unidentified, with a “?” label.

The operator may assign the identity of an unidentified (“?”) load at any time by simply touching its symbol and pressing the PAGE button until the correct load identifier appears. Press GO or just wait until the alert goes away and the system will adjust the location of the newly identified load.

If a load has been mis-identified, the operator may change that identification by pressing and holding the load symbol until the alert message appears. Then just press the PAGE button until the correct number appears, as before. The system will then swap the locations of the new and old loads in the inventory.

A supervisor can remove all load symbols from the screen by entering a special code and then pressing and holding the PAGE button.
Obstacles to crane motion

The SmartCrane system supports the entry of obstacles that the automatic move planner will consider when creating a path to a destination. The obstacles are automatically displayed on the control view window, the alternate view windows (when the crane approaches the obstacle), and on the 3D view. In the 3D view window, obstacles that can be cleared by hoisting are shown in green, while those that are too high are shown in grey.

No operator action is needed, since the automatic move planner will create a path to go over or around all obstacles. It will take into account the presence of a load on the hook(s) and the maximum hoist height of the crane.

Every obstacle has a no trespassing safety zone around it that takes into account the size of the spreader assembly and its largest load. An administrator can enter “Engineering Mode” by means of a code sequence and adjust the corners of these zones to provide a completely safe traveling environment. It’s best to do this by moving the trolley to a safe position at each corner of the obstacle.

Destinations not at floor level

If some automatic move destinations are permanently higher (platforms) or lower (wells) than the floor or ground of the crane’s field, an administrator can define these during initialization. The automatic move planner will take these heights into account when developing a vertical profile for the move. The height or depth of the destination will appear in the alternative (vertical) view windows as the crane approaches.

No operator action is required.

Crane Movement Boundaries

Automatic operation assists the operator by moving the crane and trolley to the desired destination, completely automatically, and without residual sway at the end. The moves are accurate enough to allow most operations such as setting hooks or tongs without further operator adjustments.
Auxiliary Display Pages

The upper left window is set aside for different and selectable pages of imagery and data. To get to a new page, press the PAGE button next to the GO button.

There are many pages in this selection list, however most of them are reserved for engineering mode. In normal operations, these pages include:

- 3D view
- PLC Inputs and Outputs
- System plots
- Camera data

Using the 3D View Window

In the 3D view (if installed), the operator can view the current position of the crane and, if there are multiple cranes on the same rail set networked through SmartCrane network, the positions of the other cranes. The operator can zoom in and out, rotate, tilt, and shift the center of the 3D view. The operator can also set a favorite view that will show as a second view when cycling through views.
When you touch in the 3D view it displays an overlay of sensitive control locations within that view. By touching or dragging in this view you can zoom in and out, rotate, tilt, and shift the center of the 3D view. You can also SAVE a favorite view that will show as a second view when cycling through views.

If you touch and hold in the Trolley icon, the 3D view will automatically move up/down or right/left to keep the trolley in the center of the window. Touching elsewhere in the 3D view will stop this trolley following.

**PLC Input and Output Window(s)**

In the PLC Input and Output window(s) you can examine the data being exchanged with the PLC. This window is either a single window (on larger screens with 3D display) or 3 separate windows. The data. Here is the PLC input.

<table>
<thead>
<tr>
<th>PLC INPUTS</th>
<th>BYTES</th>
<th>DECIMAL</th>
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</thead>
<tbody>
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</tr>
<tr>
<td>GANTRY VELOCITY</td>
<td>0000 0000</td>
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</tr>
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<td>GANTRY POSITION</td>
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</tr>
<tr>
<td>TROLLEY VEL DEMAND</td>
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<tr>
<td>TROLLEY VELOCITY</td>
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<tr>
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</tr>
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</tr>
<tr>
<td>TROLLEY BRAKE IS OFF</td>
<td>0000 0000</td>
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<tr>
<td>HOIST BRAKE IS OFF</td>
<td>0000 0000</td>
<td>0.0</td>
</tr>
<tr>
<td>CLAMP IS CLOSED</td>
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<td>1 FULL ANTISWAY</td>
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</table>

The important data on this page include:

- Gantry, trolley, and hoist (hang length) positions. These positions must be consistent with the true positions of the crane. If any of these positions are very large or less than zero (negative number), then the anti-sway will not operate. This usually means that the sensors defining positions have not been homed (see the next section).
• Heartbeat. If this stops changing, either the PLC communications have been interrupted or the anti-sway program has stopped. If the anti-sway program is still running, it will automatically disconnect from the PLC and try again. Until communications is restored, you will not be able to use anti-sway. (There is a small white dot at the upper left of this window that should always be flashing on and off. If that stops flashing, a restart will be required.)

• Crane ID. This must agree with the crane being operated, otherwise the anti-sway system will reject the PLC connection and restart communications.

• Load information. If your crane is equipped with a load cell sensor, then the data from that sensor appears here. Otherwise the anti-sway program will estimate load from motor readings. The functions of the load data are (1) to select the swing period correction mode (0 for empty hook, 1 for light load, and 2 for heavy load) and (2) to perform the “safe hoist” function (only when a true load cell is installed). If the wrong swing period correction mode shows at the bottom of the screen, anti-sway will not be able to prevent sway as well as expected.

• Brake release. The brakes must be released by the PLC to allow movement. A “1” indicates brake is off and ready to go.

• Anti-sway control mode. 0 is for SUSPEND, 1 is for Full Anti-sway, and 2 is for automatic moves only.

You can check what the anti-sway is demanding from the PLC. Here is the PLC output.

<table>
<thead>
<tr>
<th>PLC OUTPUTS</th>
<th>BYTES</th>
<th>DECIMAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>VELOCITY GANTRY</td>
<td>0000 0000</td>
<td>0.000</td>
</tr>
<tr>
<td>VELOCITY TROLLEY</td>
<td>0000 0000</td>
<td>-0.000</td>
</tr>
<tr>
<td>VELOCITY HOIST</td>
<td>0000 0000</td>
<td>0.000</td>
</tr>
<tr>
<td>HEARTBEAT</td>
<td>cc4 13440</td>
<td>16</td>
</tr>
<tr>
<td>CRANE ID</td>
<td>0000 0010</td>
<td>16</td>
</tr>
<tr>
<td>RELEASE GANTRY</td>
<td>0000 0000</td>
<td>0</td>
</tr>
<tr>
<td>RELEASE TROLLEY</td>
<td>0000 0000</td>
<td>0</td>
</tr>
<tr>
<td>CAMERA OFF</td>
<td>0000 0000</td>
<td>0</td>
</tr>
<tr>
<td>CLOSE CLAMP</td>
<td>0000 0000</td>
<td>0</td>
</tr>
</tbody>
</table>
The important data on this page include:

- Gantry, trolley, and hoist speed demands. These demands indicate what the anti-sway is requesting from the crane.

- Heartbeat. If this is not changing, the anti-sway program is frozen. Find the power switch and turn it off, wait a few seconds, and turn it back on again. The anti-sway program will automatically reset itself and restart when the power is restored.

- Crane ID. The anti-sway should always be sending the correct crane ID to the PLC.

- Brake release. The anti-sway will send brake release commands (1 = release, 0 = close) to the PLC. These will change to 1 when a move starts and return to 0 within several seconds of the move completion.

- Camera Status. This field may say the following:
  - NO CAMERA – There is no camera defined for this system
  - CAMERA OFF – the camera has been turned off
  - NO CAMERA COMMS – the system did not detect the camera on the network
  - CAMERA WAIT – the system is waiting for good communications with the camera
  - CAMERA ON – the camera is connected and responding
  - *CRANE* - the camera is correcting for excess sway in the crane (gantry) direction
  - *TROLLEY* - the camera is correcting for excess sway in the trolley direction

- Close clamp. When the camera is configured to automatic pickup and deliver, this is the signal from the anti-sway system to the PLC to operate the clamp mechanism.

At the bottom of the PLC output data, the summary of PLC operating conditions shows the status of limit switches, drive ready conditions, and homing.
Limit switches can be negative (-) or positive (+) meaning motion can be restricted in that direction. For instance, if a crane is parked at the extreme right (positive) end of the rail, its SLOW+ and STOP+ limit switches should both be in the *do not operate* position, which will be displayed is “NOT.” When there are no restrictions for this direction of movement, the indication is “OK.” Movement, with or without anti-sway, in the other direction is permitted if the indication is “OK.”

Each of the three drives can be “READY” or “NOT.” If any of the three show “NOT,” then anti-sway cannot operate.

Finally, each of the three directions must be HOMED in order for the anti-sway to operate. In order to home each direction the operator must move the crane past a homing switch installed in the rail, along the beam for the trolley, or near the top of hoist for the hoist. Moving the hoist to the topmost position and the down, and the trolley back and then away from the stops will normally activate the homing. You will need to learn where the homing switch is located for the crane direction.

If your crane is equipped with true absolute position sensors, homing will not be required.

**Camera Data window**

If a camera has been defined for your crane, the page sequence will always include a camera data view window. This window includes the ten most recent tracking observations from the camera, if it is connected and operating.
The far right columns of this window show the observations from the camera in pixel measure, according to the camera’s reference. Motions are opposite to the crane motion, so as the numbers increase in the crane direction, the spreader is actually swinging to the left. The center of the view is 2400 in one direction and 3200 in the other, depending on the direction the camera is facing in your installation, and are listed as biases in the bottom of the display window. Sway estimates are in seconds and millimeters. The amplitude is the maximum deviation of the spreader from one side to the other. The Zero Cross time is when the spreader passed directly beneath the trolley center, and the swing direction shows which direction the spreader was moving at the time. The Zero Cross time may be positive or negative.

**Camera Image Window**

Your installation may have the camera image available for viewing. If it does, two camera image windows will appear immediately after the camera data window. The first window shows the entire camera view and the second shows a close-up of the center of the image. Because camera image data uses so much of the communications bandwidth, each image will take about a full second to update. At first, the window will be black and will say “Waiting for camera image…”

**Motion Plot Window**

The motion plot shows a time history of crane movements. The plot only updates during a move. If you touch and hold the screen in this window, the graph and other data will be saved to disk. To stop the recording, press and hold again. Otherwise the recording will stop automatically after one hour. Recordings are available to administrators and engineers for analysis.
Read this chapter to understand how to use certain special features of the SmartCrane system.

The system includes some special features that may be installed. Ask your administrator about these features:

- Data Logging
- Remote Crane Data
- Safe Hoist
- Remote Work Orders

**Data Logging**

Pressing and holding in the upper left panel will start and stop data logging. Data logs are stored by sequence number in `/Library/Application Support/SmartCrane/Logs/CraneRecordings`. The maximum duration of one logging cycle is one hour, or 36,000 entries. An administrator may copy log files from the system.

**The PLC Data Check feature**

This feature is only for systems whose position sensors require homing but where the PLC does not tell the anti-sway the homing status.

The SmartCrane controller regularly records the crane positions on the hard drive. After a power off interval, the program checks the position data from the PLC against the last saved positions and against the maximum allowable crane boundaries.
If the positions do not agree, the SmartCrane controller will display an alert and will not move the crane in Anti-sway mode. If this occurs, the operator should check the touch screen and observe the displayed position of the crane, trolley, and hoist (hoist position is in the upper right window). The display positions represent the PLC positions, not the saved positions.

If, after careful checking against the known crane positions, the operator believes the display position are correct, he should press and hold the trolley symbol in the control view window for two seconds then release. If the PLC positions are within the permitted boundaries, the system will substitute those values for the saved positions. A confirmation alert will appear.

**Safe Hoist Check**

**This feature is only available for cranes with load sensing cells**

If the system is equipped with the SmartHoist™ feature, that feature will operate at all times, even when Antisway is turned OFF. With this feature on and the crane in position for a lift, the upward hoisting speed will be limited automatically, to provide a slow contact and taking the initial strain.

Before the hoist can move the load, the system will sense whether the hoist is taking its proper load. If not, the hoisting will stop automatically and an alert will show on the SmartCrane screen. There may also be an external audible and/or visible alarm. The alerts and alarms will stop as soon as the hooks begin to be lowered.

This feature protects against foul lifts in these conditions:

- Container Cranes: not all four twistlocks connected;
- Ladle Cranes: Only one hook connected OR a hook connected at the tip instead of throat;
- Slab/tong Cranes: Only one set of tongs connected; and
- Slab/tong Cranes with accurate inventory: Slab lifted off-center.

If the alert occurs but a trusted agent, in a position to examine the situation, confirms that the hooks are properly engaged, the alert can be canceled by touching the SmartCrane screen. Hoisting can then continue uninterrupted. Depending on the installation, a separate button may also be designated to cancel the alarm.
If false alarms continue, contact a supervisor for system re-training.

**Training Mode**

A user may practice using the features of the SmartCrane interface, without moving the crane, by selecting training mode. The top row of saved destination buttons are numbered 1, 2, 3... left to right.

Enter the training mode code **5-6-2-7-1** by pressing the correct buttons in sequence. It may take more than one attempt to enter this code. When the code is accepted, an alert will appear confirming training mode. While in training mode, the PLC data screens will indicate that all data is simulated.

To exit training mode, press the LOGOUT button once and release. The system will confirm the return to normal operation.