



MicroGuard 540 Rated Capacity Limiter



Service Manual

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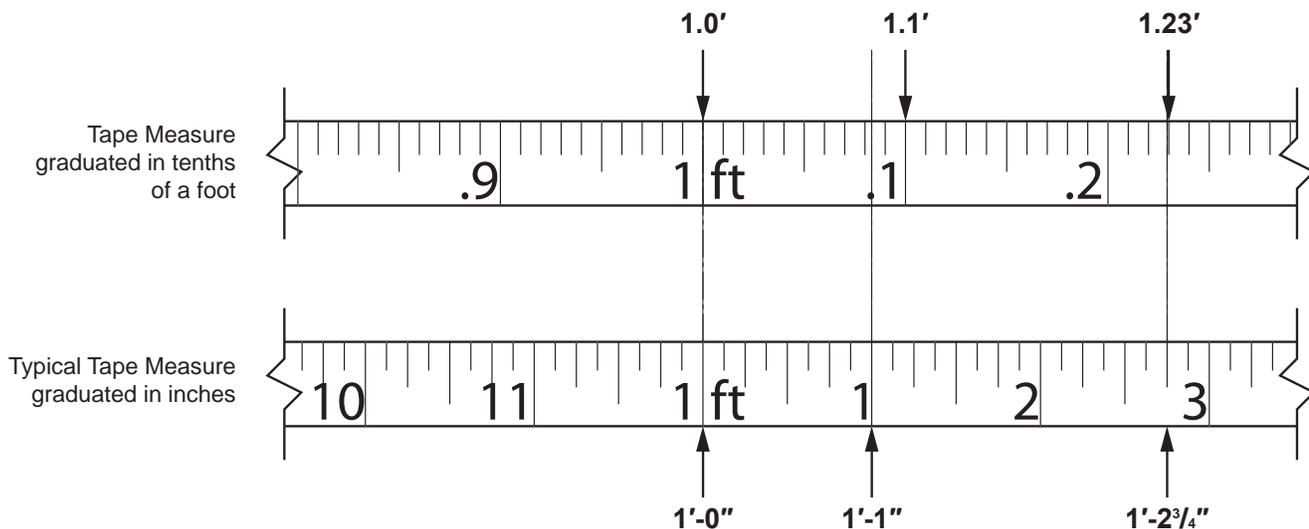
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Introduction

This manual describes the troubleshooting process for the Link-Belt MG-540 Rated Capacity Indicator System (hereinafter referred to as “the system”) in an on-site environment.

Required Tools

- 1/4” nut driver or T15 Torx driver
- Digital or bubble level calibrated and accurate to 0.1° at level
- 100 foot measuring tape - fiber type graduated in tenths of feet



Note: The computer calculates measurements in feet and tenths of a foot, so having the correct measure will facilitate entering measurements.

- Digital volt/Ohm Meter capable of measurements to three decimal places

Number Conversion

If you are using a standard tape measure, the measurement must be converted into feet and tenths of a foot. For example: a distance of 35'-6" would be entered into the system as 35.5 feet. Whole inches can be easily converted by dividing by 12 ($6/12=.5$). Fractions of an inch are converted by dividing the numerator by the denominator. For example: 1/4 inches would be entered as .25 ($1/4=.25$). Conversion of whole inches and fractions of an inch (for example 6-1/4") are converted by first converting the fraction to a decimal and then dividing by 12. In this case 6-1/4" is converted to 6.25 and then divided by 12 which equals 0.520.

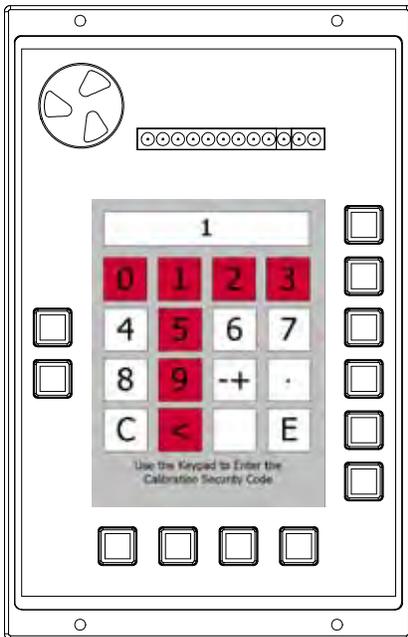
When entering weights, the number must be converted by moving the decimal three places to the left. For example: a weight of 1,400 pounds would be entered as 1.4, and a weight of 300 pounds would be entered as .300.

Number Entry

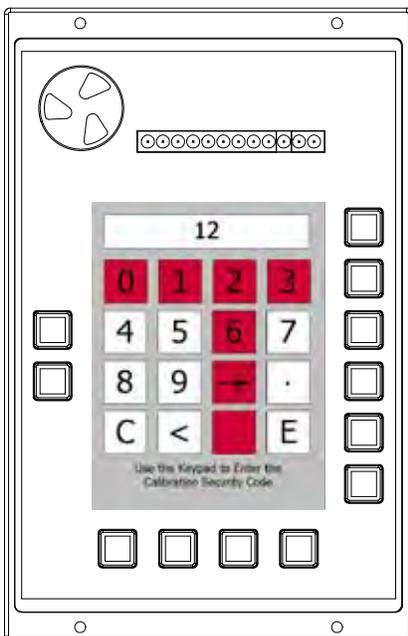
The system display does not use a numeric keypad. Instead, a range of numbers and characters is assigned to a particular key.

To select a particular number, press the key adjacent to the corresponding horizontal row containing the desired number.

Once the desired row is highlighted, press the key below the corresponding vertical column to enter the number.

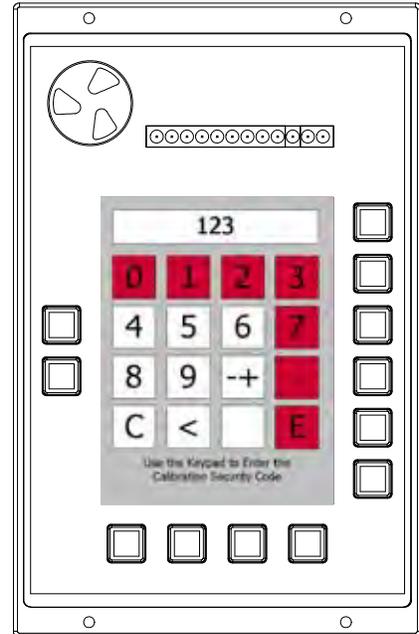


For example: To enter the numbers 1, 2, 3; first select the horizontal row containing the number "1" and then select the intersecting vertical column.

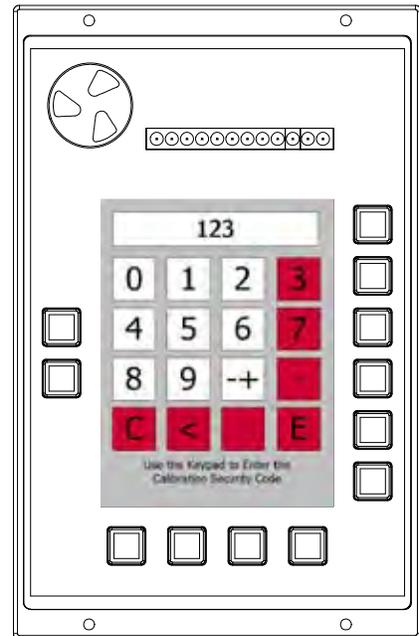


Then, select the horizontal row containing the number "2" and then select the intersecting vertical column.

Then select the horizontal row containing the number “3” and then select the intersecting vertical row.



When all numbers have been selected, highlight the “E” key in the same manner.



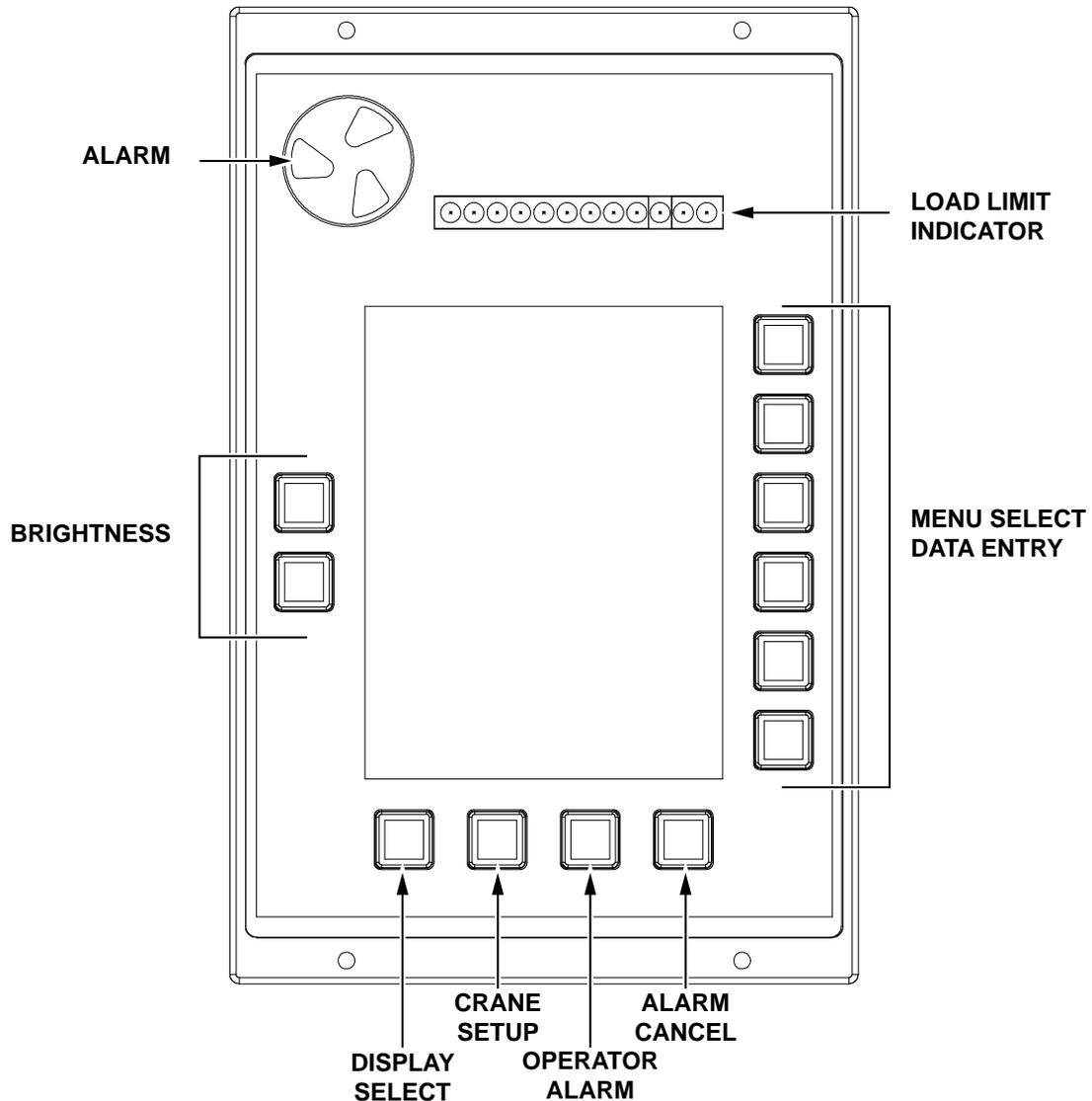
When entering negative numbers, select the negative symbol [-] first.

Decimal points are entered the same as numbers.

If an error is made in data entry, selecting the “<” symbol and pressing the key in the corresponding vertical column will delete one character. Selecting the “C” symbol and pressing the key in the corresponding vertical column will erase the entire entry.

Selecting the “E” symbol will cancel the number entry procedure.

The Display



The **Alarm Speaker** sounds approaching overload; overload; violation of operator settable alarms; and other alarm violations.

The **Brightness** keys increase and decrease the brightness of the display and optional mini-load limit indicator (if installed, see page 24)

The **Load Limit Indicator** notifies the operator of load limit, approaching overload (amber lights), and overload (red lights).

The **Menu Select/Data Entry** keys are used to select configuration and select menus and data values during calibration.

The **Display Select** key is used to view error codes and enter calibration mode.

The **Crane Setup** key is used to configure the crane.

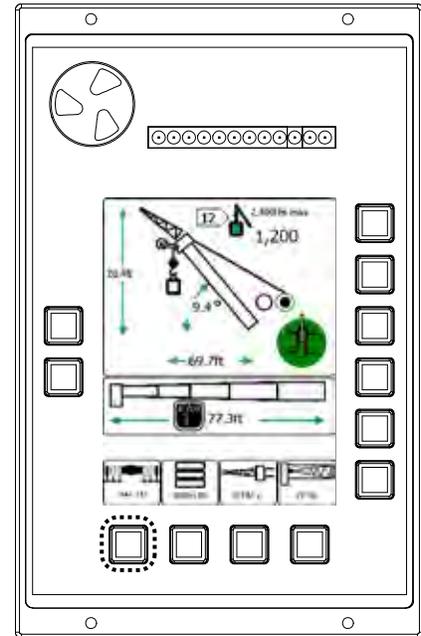
The **Operator Alarm** key is used to configure operator settable alarms.

The **Alarm Cancel** key is used to mute the Alarm Speaker.

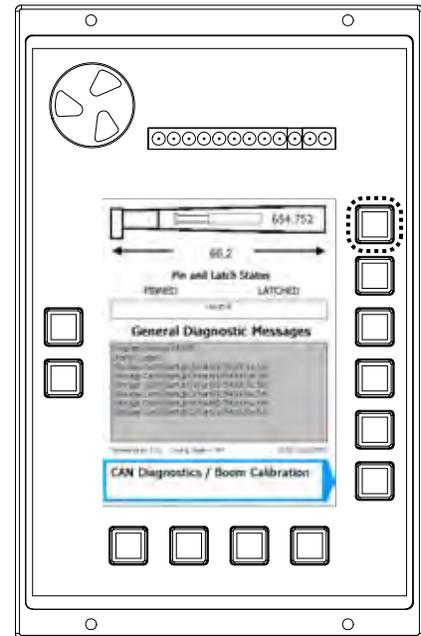
Calibration Mode

Use of the functions described in this manual requires that the system be in the calibration mode of operation.

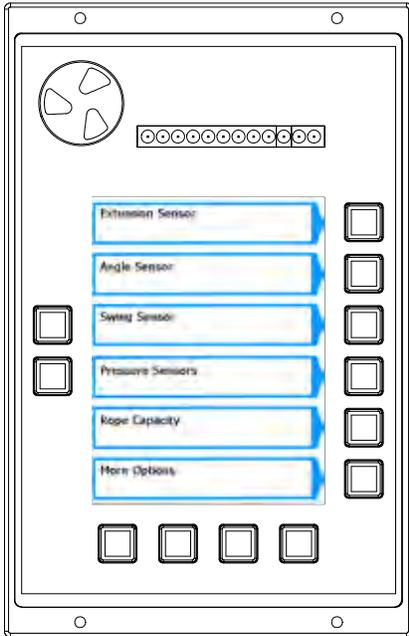
From the normal working screen, press the “Display/Select” key.



Press the uppermost-right key.



Enter the calibration code sequence. Use the number entry procedure as shown on page 3. The calibration code is 1-2-3. If the sequence is entered incorrectly, the calibration will be aborted and the normal working screen will appear.



The calibration menu will appear upon entering the calibration code.

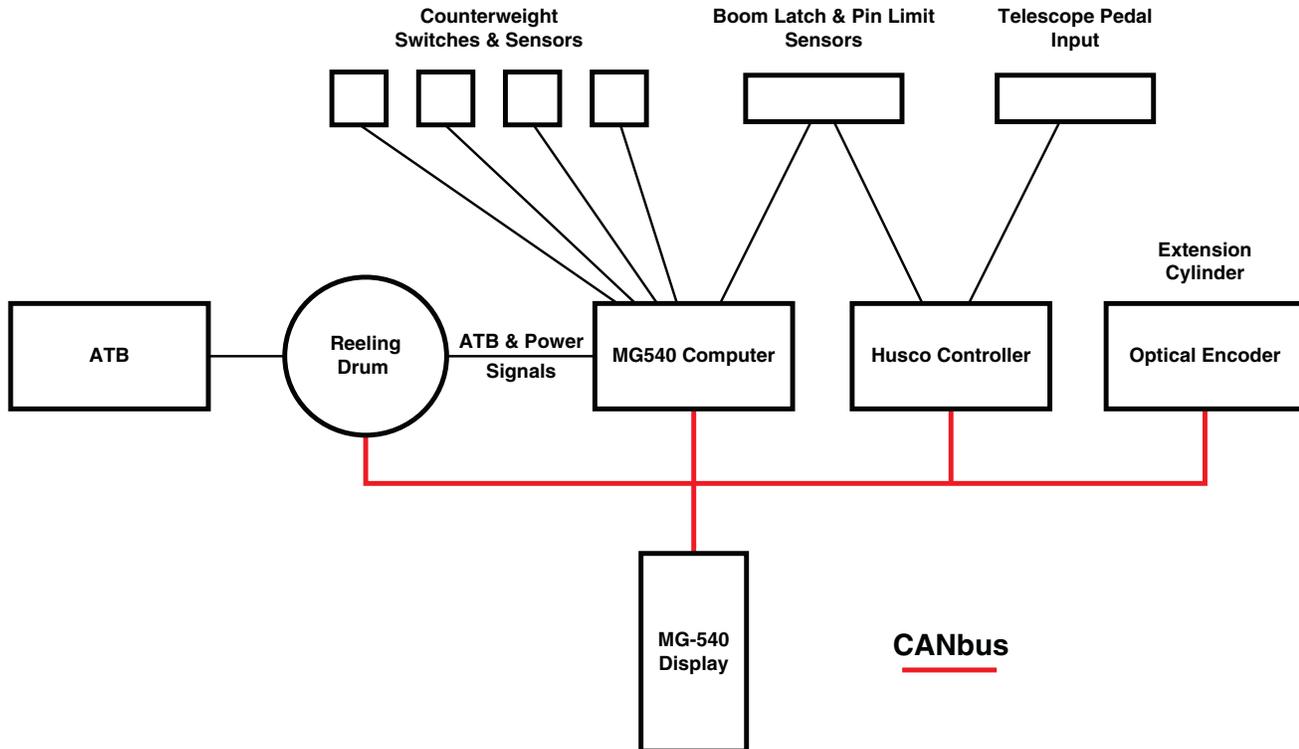
⚠WARNING

WHEN IN THE CALIBRATION MODE, THE TWO-BLOCK ALARM AND FUNCTION KICKOUT ARE DISABLED.

System Overview

The MG-540 is part of a Controller Area Network (CAN), also referred to as CANbus. The CAN contains multiple controllers, linked together much like an office computer network, which communicate with each other and share information.

The system includes the MG-540 computer, the Husco controller, the Optical encoder, an operator's display console, an extension reel, and various cables and sensors. The system is designed to measure and load weight, calculate and maximum capacity and percent of rated capacity, and warn of an approaching overload or two-block condition for each crane configuration. All of this information is shown on the MG-540 display.



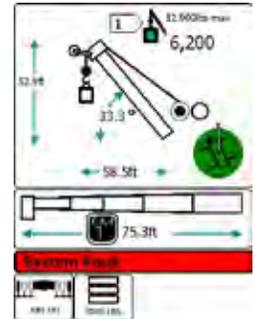
Problem Finder

This section is designed to aid in determining the location and type of problem experienced. It is important to follow the recommendations within this section before contacting the Greer Company.

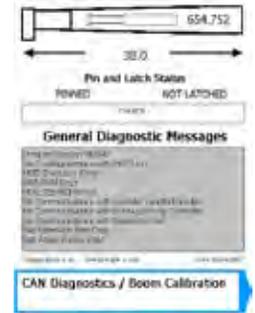
System Self-Test

On initial startup, the system will check communication between sensors.

If communication cannot be established, the system will display a fault on the working screen.



Press the “Display/Select” key on the display to go to the General Diagnostics screen to determine which component is not communicating.



Display Console Problems

Display console problems are difficult to isolate because of the interaction between the display console and the computer unit. Failure of either unit, or interconnection of the two units, causes malfunction of display console indications. No “FAULT” diagnoses of other system problems can be carried out without the proper function of the display console and its communication with the computer unit.

To solve problems using display console indications, carefully observe the display console at “power on” and through self-test. Next, use the following chart to help decide the course of action.

Problem	Action
There are no display console indications at all when power is turned on. All displays remain blank and no lights are illuminated.	<ul style="list-style-type: none"> • Check permanent power voltage. Refer to machine electrical schematic for fuse location. • Check key switch power for proper voltage (12v). Refer to machine electrical schematic for fuse locations.
The red or yellow indicator lights do not illuminate during self-test.	<ul style="list-style-type: none"> • Replace display console.

Problem	Action
The display console does not do the self-test. No words or logical numbers ever appear after power is turned on. The displays look jumbled, with lots of missing segments.	<ul style="list-style-type: none"> • Replace display console.

Fault Reporting And Fault Codes

System fault codes provide one of the most important ways to quickly locate and assess problems in the system. Please review this section carefully.

Each time the system is turned on, it goes through a self-testing process lasting eight seconds that automatically detects most faults in the system.

Many fault conditions are detected without a system self-test.

Faults detected in the system during the self-test, are indicated on the display console in the following ways:

- The RED OVERLOAD LAMP will illuminate.
- The AUDIBLE ALARM will sound.
- “SYSTEM FAULT” will be displayed in the lower portion of the graphics display.

System Fault

If a communication error occurs between the components, a “System Fault” message will appear in the main working screen.

From the main working screen, press the **Display/Select** key.

The diagnostics screen will appear showing no communication with the faulty component.

CAN Diagnostics

The CAN diagnostics screen will display the status of the CAN components.

“No Fault Code” Problems

This section addresses those problems that may occur and are not reported by the computer fault code system.

Anti Two-Block (ATB) Alarm

This section gives direction to fault diagnosis of ATB alarm problems. For detailed information, schematic, and voltages, refer to “Anti Two-Block (ATB) Function” on page 42.

Problem

The ATB alarm is continuously on. Operating the switch at the boom head does not deactivate the alarm.

This problem suggests an open circuit between the computer ATB input and the ATB switch(es), or an open circuit between the computer ATB feed and the ATB switch(es)

1. Check extension reel-off cable for damage.
2. Make sure that the Two-Block switches are correctly connected.
3. Check the slip-ring and wiring inside the extension reel.

4. Check the signal cable from the extension reel to the computer. Check connectors (J305).

Problem

The Anti Two-Block alarm is continuously OFF (safe). De-operating the switch at the boom head, by lifting the ATB weight does not activate the alarm.

This problem suggests a short circuit between the computer ATB input and the computer ATB feed somewhere between the computer and the ATB switch(es).

1. Check extension reel-off cable for damage.
2. Make sure that the Two-Block switches are correctly connected.
3. Check the slip-ring and wiring inside the extension reel.
4. Check the signal cable from the reel to the computer. Check connectors (J305).

Displayed Load Or Radius Errors

This section gives direction to fault diagnosis of load and radius errors as displayed on the display console. Load or radius errors may give rise to early or late tripping of overload alarms. Accuracy of load, radius, length, and angle is determined by the correct installation and maintenance of the system sensors.

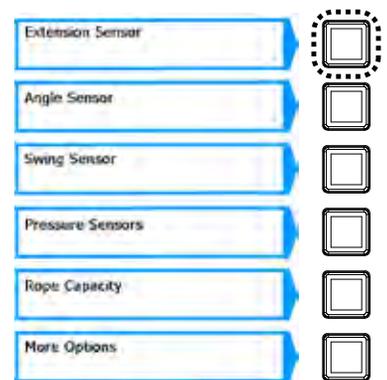
Accuracy of load is governed by the radius accuracy, and the extension, angle, and pressure sensors.

Accuracy of radius (unloaded) is governed by the extension and angle sensors.

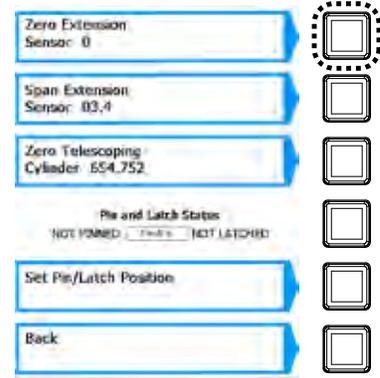
Before continuing, make sure that there are no system faults.

Check Boom Extension

1. First check that the boom is fully retracted.
2. Check that the extension reel-off cable is correctly layered as a single layer across the extension reel surface. Any stacking of the cable will cause extension errors when the boom is fully retracted, causing the system to exceed the 0.5 ft. tolerance allowed by the computer for boom mode selection. If the reel-off cable is stacking on the reel, refer to “Checking the Reel-Off Cable Layering” on page 26.
3. Check the zero of the extension sensor at the fully retracted boom position.
4. Enter calibration mode (on page 6).
5. From the calibration menu, cycle through the selections until “Extension Sensor” appears. Press the key adjacent to **Extension Sensor**.



6. Ensure the boom is fully retracted and press the key adjacent to **Zero Extension Sensor** to set the extension to zero. **DO NOT PRESS THE "SPAN EXTENSION SENSOR" KEY WITH THE BOOM FULLY RETRACTED. IF THIS HAPPENS, THE MANUAL BOX WILL HAVE TO BE CONNECTED AND THE BOOM EXTENDED MANUALLY.**
7. Before exiting the command, ensure that the displayed value is between -4 and +4.
8. If the extension value is incorrect, refer to "Extension Sensor Setup" on page 28.
9. Fully telescope the boom and check that the displayed boom length value matches the maximum length of the boom. If the length value is incorrect, refer to "Span Calibration" on page 30.



IMPORTANT!

THE REQUIRED ACCURACY OF TAPED RADIUS MEASUREMENTS IS WITHIN 0.1 FEET.

WHEN TAKING RADIUS MEASUREMENTS; ALWAYS USE A GOOD QUALITY TAPE THAT DOES NOT STRETCH. THE TAPE SHOULD BE GRADUATED IN FEET AND TENTHS OF FEET. ALWAYS MEASURE BETWEEN THE SWING CENTER OF THE CRANE AND THE HOOK LINE, USING A SINGLE PART OF LINE, WITH THE CRANE CENTERED OVER FRONT (ROUGH TERRAIN CRANE) OR CENTERED OVER REAR (TRUCK CRANE).

Check Main Boom Radius

1. Fully retract the boom and make sure that the crane configuration is correctly set up.
2. Boom up to about 45° and measure the radius. The measured radius must match the displayed radius within +/- 0.2 ft. If it does not match, refer to "Check Boom Angle" on this page. If it does match, refer to "Check Pressure Sensors" on page 13.

IMPORTANT!

THE REQUIRED ACCURACY OF MEASURED ANGLES IS WITHIN 0.2°.

WHEN TAKING BOOM ANGLE MEASUREMENTS; ALWAYS USE A GOOD QUALITY INCLINOMETER. MANY INCLINOMETERS ARE ONLY ACCURATE AT 0° (LEVEL). MAKE SURE THAT A RELIABLE POSITION ON THE TOP OF THE BOOM IS USED TO MEASURE THE ANGLE AND THAT THE INCLINOMETER WILL PROVIDE AN ACCURATE READING AT 0° (ZERO) AND AT 70°.

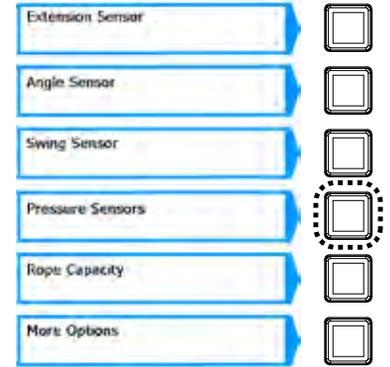
Check Boom Angle

1. Fully retract the boom.
2. Using an inclinometer, set the boom to 0° (zero) and check that the displayed boom angle value is 0.0°. If the angle value is not 0.0°, refer to "Checking the Angle Sensor Pendulum" on page 31, "Physical Zero" on page 32, and "Zero Calibration" on page 33.
3. Boom up to a high angle (at least 70°) and measure the angle with the inclinometer. Check that the displayed angle matches the inclinometer reading within 0.2°. If the displayed angle is incorrect, refer to "Span Calibration" on page 34.

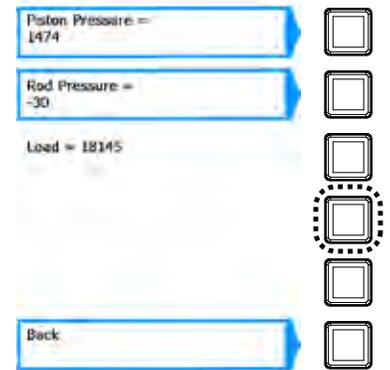
Check Pressure Sensors

The Pressure sensing system is factory calibrated, therefore pressure sensors may not be individually replaced. Any serious problems will necessitate changing the whole computer unit.

1. Boom fully down until the boom hoist cylinder is fully retracted and on its stop.
2. Loosen both hydraulic connections to the pressure sensors to guarantee zero pressure is present on the sensors.
3. Enter calibration mode (see page 6).
4. From the calibration menu, cycle through the selections until Pressure Sensors appears. Press the key adjacent to **Pressure Sensors**.



5. Check the PRESSURE values of both sensors. They should be between -75 and + 75 PSI. If not, replace the computer unit.



Boom Mode Selection

This section gives direction to fault diagnosis of BOOM MODE selection problems.

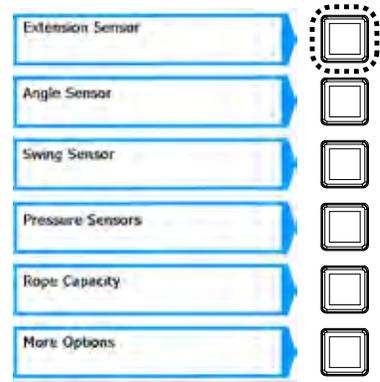
The system provides an output from the display unit via the CANBus to the Husco Boom Controller for boom mode selection. The system allows the operator to select any available boom mode only when the boom is within 0 to 0.5 ft. of fully retracted.

If "CRANE SETUP" does not allow selection of a new boom mode:

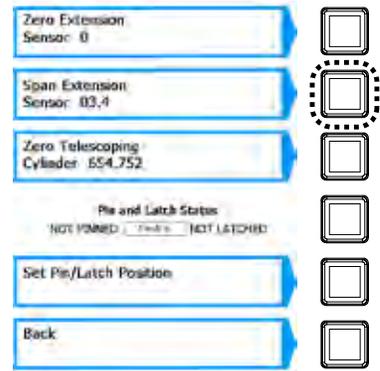
1. First check that the boom is fully retracted.
2. Check that the extension reel-off cable is correctly layered as a single layer across the extension reel surface. Any stacking of the cable will cause extension errors at fully retracted, which will exceed the 0.5 ft. tolerance allowed by the computer for boom mode selection.
3. If the reel-off cable is stacking on the reel, refer to "Checking the Reel-Off Cable Layering" on page 26.
4. Check the ZERO of the extension sensor at fully retracted.

5. Enter calibration mode (see page 6).

6. From the calibration menu, cycle through the selections until “Extension Sensor” appears. Press the key adjacent to **Extension Sensor**.



7. Ensure the boom is fully extended and press the key adjacent to **Zero Extension Sensor**.

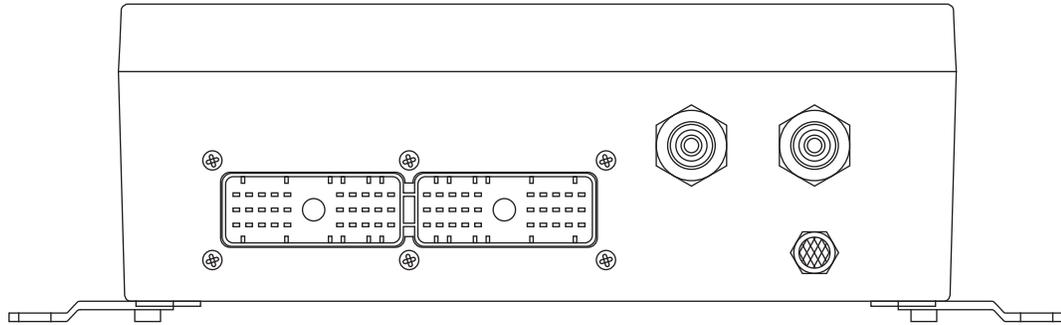


8. If the extension value is incorrect, refer to “Extension Sensor Setup” on page 28.

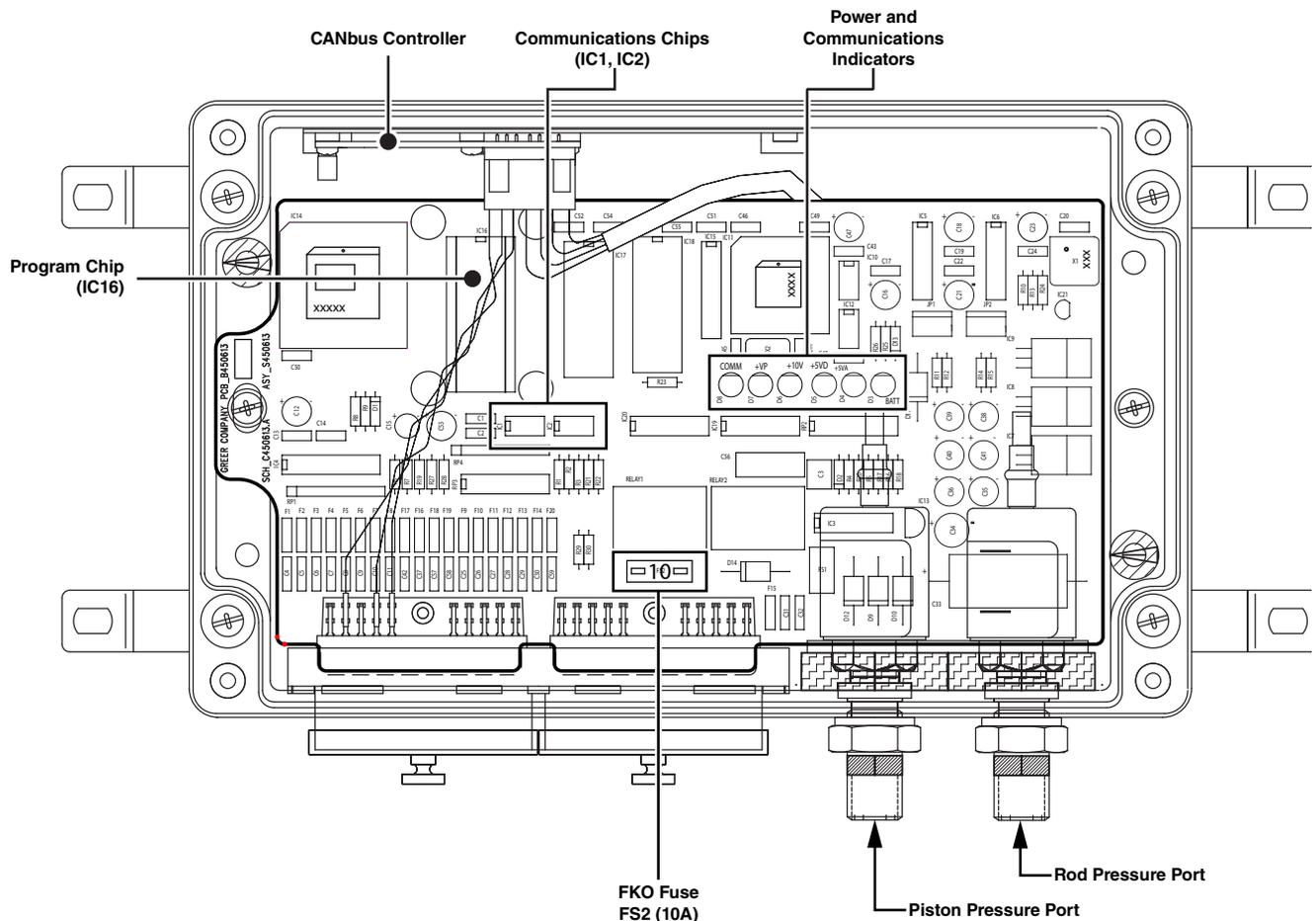
Computer Unit

Computer Unit Overview

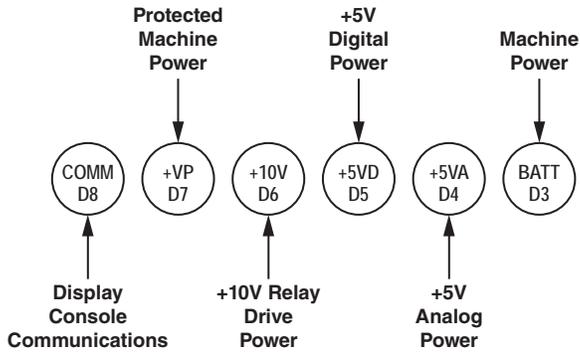
The computer unit is an interface between the display and other controllers on the crane. The computer unit directly connects to the crane wiring harness via a 60-way bulkhead connector. There are no wiring connections or screw terminals within the unit. Contained within the unit, are the two hydraulic pressure transducers required to sense pressure within the boom hoist cylinder.



Computer Unit Layout



Internal Status Indicators



The computer unit contains a row of indicators to aid in checking power supply and communications operation within the system. Remove the lid of the computer and check these indicators. Refer to the computer unit layout on page 15.

All the indicators are bright green light emitting diodes. There are five power indicators and one communication indicator [COMM]. With the exception of the COMM indicator, all indicators should be

illuminated at the same brightness level with the system power on.

A missing or dimly lit indication points to a power supply problem. Check the indicator chart below for repair actions.

Indicator States	Action
	Check crane power and circuit breaker.
	+VP power to display console shorted to crane ground. Check display console / load indicator cabling.
	+10V relay power internal short or regulator failure. Replace computer.
	+5VD digital power internal short or regulator failure. Replace computer.
	+5VA analog power / drive to sensors. Check extension reel connection inside reel and wiring to extension reel.

The COMM Indicator

The COMM indicator provides an indication of the success or otherwise of communication with the display console, and of the running state of the computer program.

Carefully observe the COMM indicator and the display console at power on and through self-test; then, use the following chart to help decide the course of action.

COMM Indicator Indications At Power On	Action
From the moment the power is applied, the COMM indicator does not illuminate. During and after the self-test period of eight seconds, the COMM indicator remains off.	The computer is not running. Check status indicators. Refer to "Internal Status Indicators" on page 16. Try to reset the system by powering off and on again. Listen to the computer for the relays to click. If they do not click, replace the system chip. If not successful, replace the computer. If the relays do click, replace communication chips IC1 and IC2. Refer to "Communications Chips (IC1 and IC2) on page 18.
From the moment system power is applied, the COMM indicator flashes at a fast rate and never stops. The display shows Communication Error.	Communication with the display has not been made. Check connector at rear of the display console.
At the moment power is applied, the COMM indicator flashes briefly, then switches off. After a few seconds, the COMM indicator starts to flash at a fast rate and never stops.	This is the normal operation of the communication between the computer and display console. If there are any problems with indications on the display console, refer to "Display Console Problems" on page 9.

Computer Unit Replaceable Parts

The COMPUTER UNIT contains three parts that may be replaced in the field:

- A standard 10 amp automotive fuse, protecting the power feed to the function kickout circuit, is located on the circuit board within the unit.
- Communications chips (IC1 and IC2) that communicate with the display console and are pluggable.

Function Kickout Fuse (FS2)

The computer unit contains a replaceable fuse that protects the function kickout circuit and relay contacts, in the event that a short circuit across the crane kickout solenoids occurs.

The fuse, identified as FS2 on the computer board, may be replaced in the event that system error codes indicate that the function kickout power feed is missing, and it has been established that the crane circuit breaker is closed and power from the crane is present.

Before replacing the fuse, make sure that any electrical shorts that may have caused the failure of the original fuse have been removed.

⚠WARNING

WHEN REMOVING AND INSTALLING THE FUSE, ENSURE THAT THE CRANE POWER IS TURNED OFF.

Communications Chips (IC1 and IC2)

The computer unit contains two replaceable communications chips (see illustration on page 15).

The communications chips, identified as IC1 and IC2, on the computer board provide communication of data between the computer unit and display console (as well as load indicator unit, if fitted). These chips are pluggable and replaceable. Replacement of the communications chip does NOT necessitate recalibration of the System.

It is unlikely that the communications chips will become damaged, but in the event that the COMM indicator remains off at all times, changing these devices may provide a solution. See “Internal Status Indicators” on page 16 and “The COMM Indicator” on page 17.

Communications Chips Removal

1. Turn the power off.
2. Remove the chip from the computer board with a chip removal tool.

Communications Chips Installation

1. Use an installation tool to insert the new chip into the socket.
2. Ensure that the dot on the top of the chip is at the same corner as the IC1, IC2 legend on the circuit board.
3. Ensure that all pins are properly inserted into the chip socket. These pins are very easily bent.

⚠WARNING

WHEN REMOVING AND INSTALLING CHIPS, ENSURE THAT THE POWER IS OFF. DO NOT TOUCH THE CHIP PINS UNLESS YOU ARE PROPERLY GROUNDED. STATIC ELECTRICITY CAN DAMAGE CHIPS.

ALWAYS USE A PROPER CHIP REMOVAL TOOL. USE OF SCREWDRIVERS, FINGERS, OR OTHER IMPLEMENTS MAY DAMAGE THE CHIP OR SERIOUSLY DAMAGE THE CIRCUIT BOARD. RECOMMENDED CHIP REMOVAL AND INSTALLATION TOOLS MAY BE OBTAINED FROM NEWARK ELECTRONICS STOCK NO. 10F7494 AND 10F7497.

FAILURE TO HAVE ALL PINS INSERTED PROPERLY INTO THE CHIP SOCKET MAY CAUSE DAMAGE TO THE SYSTEM AND THE CHIP.

Pressure Sensors

There are two pressure sensors installed as part of the system. Both pressure sensors are mounted within the computer unit and electrically connected to the computer board within. One is connected to the piston side of the boom hoist cylinder via a flexible hose; the other to the rod side of the boom hoist cylinder via a flexible hose. Piston side hose is protected by a velocity fuse within the boom hoist cylinder valve block on the end of the cylinder(s).

The pressure sensor on the piston side is subject to the hydraulic pressure necessary to support the weight of the boom, any attachments, and the load. The other sensor monitors the pressure necessary to control down motion of the boom. The computer unit uses this information (along with that from other sensors such as extension, length, and angle) to compute the weight of the suspended load.

⚠WARNING

BOTH PRESSURE SENSORS ARE FACTORY PRE-CALIBRATED AND SUPPLIED AS PART OF THE COMPUTER UNIT. REMOVAL OR REPLACEMENT OF THESE DEVICES FROM THE COMPUTER, INVALIDATES WARRANTY AND WILL ADVERSELY AFFECT THE PRESSURE CALIBRATION.

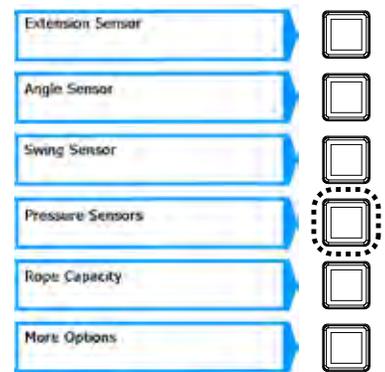
The maximum continuous working pressure for these devices is 250 bar (3625 PSI).

Checking Pressure Sensors

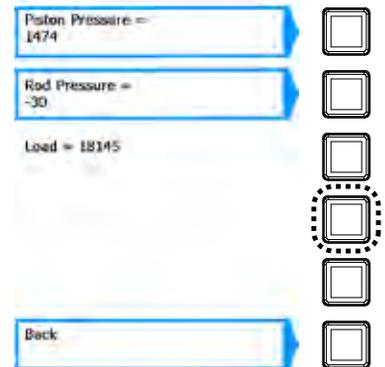
The pressure sensing system is factory calibrated, therefore pressure sensors may not be individually replaced. Any serious problems will necessitate changing the whole computer unit.

1. Boom fully down until the boom hoist cylinder is fully retracted and on its stop.
2. Loosen both hydraulic connections to the pressure sensors to guarantee zero pressure is present on the sensors.
3. Enter calibration mode (see page 6).

4. From the calibration menu, cycle through the selections until Pressure Sensors appears. Press the key adjacent to **Pressure Sensors**.



5. Check the PRESSURE values of both sensors. They should be between -75 and + 75 PSI. If not, replace the computer unit.



Replacing The Computer Unit

Removal

1. Boom down all of the way so that the boom hoist cylinder is fully retracted or the boom is firmly in the boom rest.
2. Disconnect hydraulic connections at the computer unit.
3. Note which hose is connected to the piston and rod pressure ports.
4. Disconnect both electrical connectors at the computer unit.
5. Remove the hardware securing the computer to the cab wall.

Installation

1. Secure the computer unit to the cab wall with the mounting hardware.
2. Ensure that the electrical connections face downward.
3. Remove the two protective covers from the electrical bulkhead connector.
4. Connect the electrical connectors.
5. Remove the protective caps from the hydraulic ports.
6. Connect the base-side pressure hose to the piston pressure port.
7. Connect the rod-side pressure hose to the rod pressure port.

Display Console

Display Console Overview

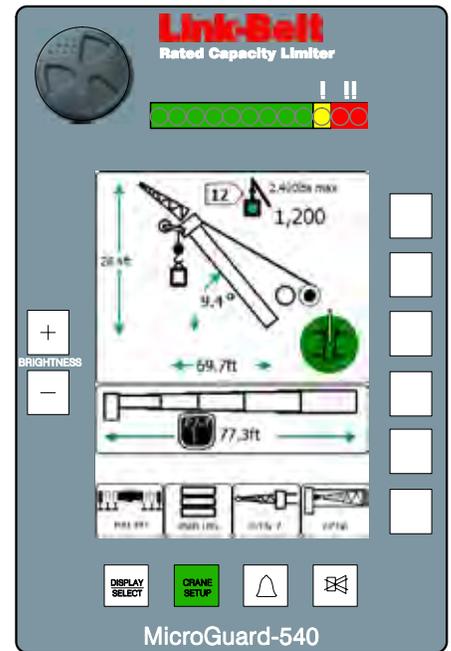
The operator's display console allows the user to see the crane values (angle, radius, load, etc.) and crane configuration selection. The display also provides calibration functions used for testing and fault diagnosis.

Checking The Display Console

The operator's display console is normally very reliable. However, when operated for extended periods, under extreme conditions, the console can become damaged. The damage is not always apparent. To help identify subtle faults that are sometimes difficult to find, or that may be attributed, mistakenly, to other kinds of problems, please review the following comments.

Reading The Display

The most commonly encountered problem is caused by reflections or bright light conditions. It may not be possible to correct this problem completely, especially on flush-mounted display consoles exposed to bright sunlight. If the problem concerns the contents of one or more of the display screens, refer to "Display Console Problems" on page 9.



Buttons That Don't Respond

All button options are not available for use at all times. Ensure that the non-responsive button is programmed to respond at that point in the operation of the System. Press the button in the center. Pressing the printed symbol 'at one end' may not activate the switch underneath. Buttons that are damaged or have a surface that is worn may cause the switch underneath to operate improperly. In this case, refer to "Display Console Removal and Installation" on page 22.

Connectors

A single circular connector, common to all display models, is positioned on the rear of the display console. This connector carries power and signals from the computer unit to the display console. Examine this connector carefully. It is possible for the pins and sockets within the connector halves to bend, break, or 'be pushed back' inside the housing.

Moisture

The display console offers adequate protection against dust and water, when correctly installed. However, they are unlikely to fully protect the sensitive electronic assemblies inside against pressure-washing or heavy rainfall. In this case, replace the console, especially if moisture is visible behind the display windows.

Display Console Removal and Installation

Removal

1. Remove and set aside the four mounting screws on the defective operator's display console.
2. Remove the compact flash card from the defective display unit (see "Compact Flash Card" on this page).
3. Disconnect the cable from the connector on the rear of the defective operator's display console.

Installation

1. Install the compact flash card into the new display (see "Compact Flash Card" on this page).
2. Attach the electrical cable to the electrical connector on the new console.
3. Attach the new display console to the cab with the four mounting screws.

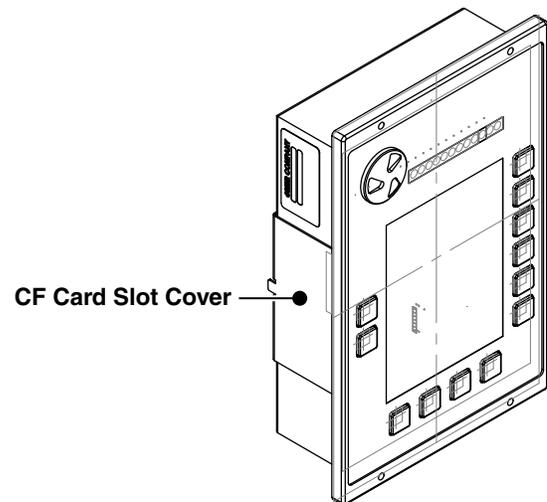
Compact Flash Card

The system runs a version of Microsoft® Windows and the crane operation program, duty, and calibration data is stored on a compact flash (CF) card which is inserted into a slot in the display console. In some cases, the CF card may become dislodged or corrupted and will need to be re-inserted or replaced.

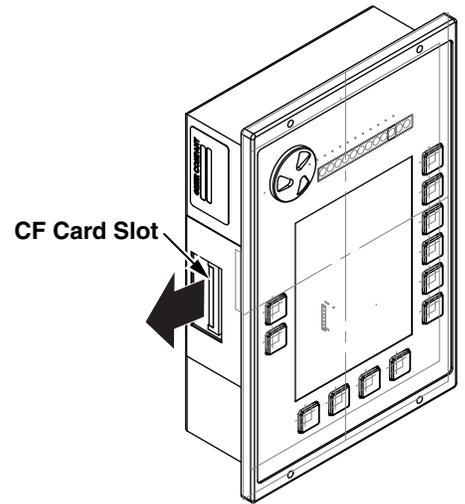
Removal and Installation

1. Follow the procedure described in "Display Console Removal and Installation" on this page.

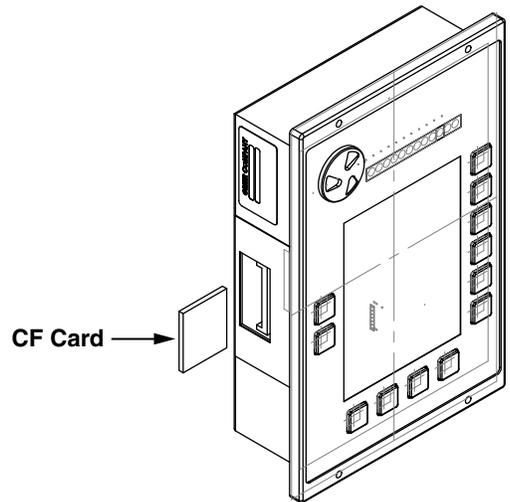
2. Remove the CF card slot cover. It is attached magnetically so no tools are required.



3. Do not use any tools to remove the card. To remove the card, pull on the card out from the CF card slot.



4. Remove the card.



5. To re-insert the card, or to insert a new card, slide the card into the slot in the proper direction and orientation. The card can only be inserted one way. Do not try to force the card into the slot.
6. Push gently on the card until it it stops and locks its place.

Remote Load Indicator

Remote Load Indicator Overview



The remote load indicator displays the percentage of rated capacity of the crane. The remote load indicator is mounted at the right side of the operator in the cab. Defective remote load indicators cannot be serviced in the field and should be replaced.

Checking The Remote Load Indicator

The remote load indicator is normally very reliable. However, when operated for extended periods, under extreme conditions, the device can become damaged. The damage is not always apparent. To help identify subtle faults that are sometimes difficult to find, or that may be attributed, mistakenly, to other kinds of problems, please review the following comments.

Lamps

The lamps are light emitting diodes (LED's). They are more reliable than standard incandescent bulbs and consume far less power. Always replace the entire load indicator unit if it is found to be faulty.

With the system powered, there should always be at least one (green) LED lighted, even when there is no load suspended. The remote load indicator LED's should 'track' or 'echo' the load indicator on the operator's display console at all times.

Cable and Connector

The remote load indicator uses a single cable to communicate with the display and to carry power. The cable is non-removable and is a fixed length. Excess cable should be stored (not discarded) when the unit is installed. Extending this cable is not recommended.

There is a single connector on the far end of this cable. This connector carries power and various signals between the display and the remote load indicator. Because of the nature of connectors, it is possible for the pins and sockets within the connector halves to be damaged. A pin may be bent, broken, or 'pushed back' inside the housing.

Moisture

The remote load indicator offers adequate protection against dust and water when correctly installed. It is not possible, however, to fully protect the sensitive electronic assembly inside against pressure-washing or heavy rainfall. If this occurs, the remote load indicator should be replaced.

Remote Load Indicator Replacement

Removal

1. Turn off the power.
2. Remove the display console in order to access cabling in connectors.
3. Disconnect the remote load indicator cable from the display console wire harness at the rear of the display console.
4. Remove the gauge panel and remove the two (2) retaining nuts and washers that secure the remote load indicator to the gauge panel.

Installation

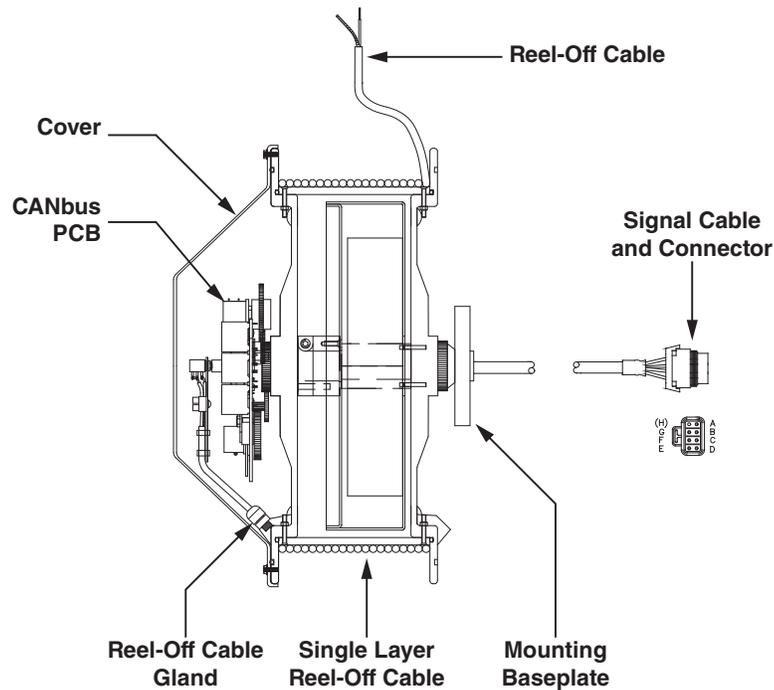
1. Place the new remote load indicator in position on the gauge panel and reinstall the two (2) washers and retaining nuts.
2. Reinstall the gauge panel.
3. Route the cable to the display console and connect the cable.
4. Reinstall the display console.
5. Turn on the power and ensure that the remote load indicator operates correctly.

Extension Reel

Extension Reel Overview

The primary operation of the EXTENSION REEL is to measure the extension of the telescoping sections of the main boom. The extension reel also includes an angle sensor to measure the main boom angle, and an electrical slip-ring which transfers the ATB signal from the reel-off cable to the system computer.

The extension reel is designed to provide a very accurate measurement of extension and angle. It is important that the setting up and maintenance of these devices be properly carried out as per the procedures contained within this manual. Incorrect maintenance will result in system calculation errors.



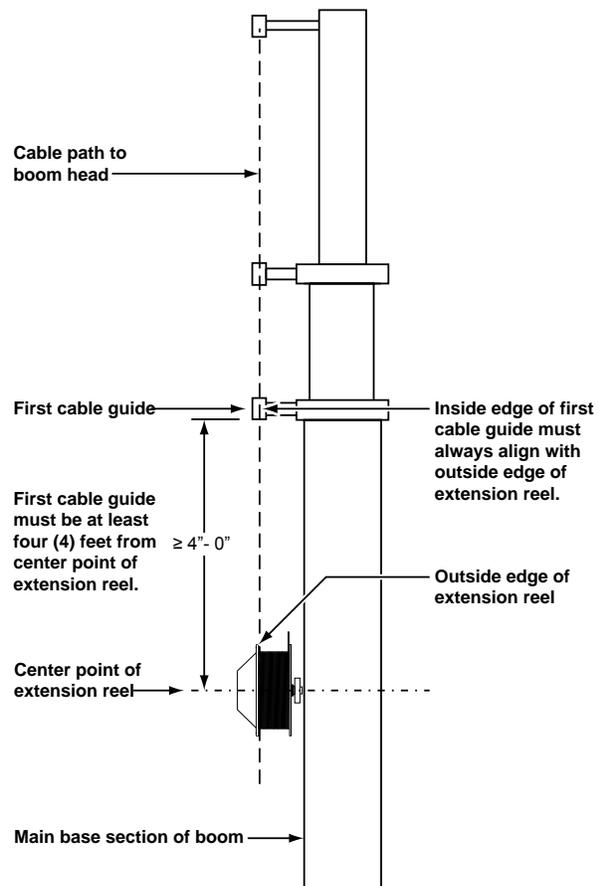
Checking the Reel-Off Cable Layering

The extension reel is designed to provide accurate measurement of boom extension when the REEL-OFF CABLE forms a single flat layer across the surface of the extension reel as the boom is telescoped in and out. Any stacking of the cable will cause extension errors as the boom retracts.

1. Telescope the boom fully out and then fully in.
2. Check that the reel-off cable forms a flat single layer across the surface of the extension reel, with each successive turn of cable laying next to the last.

If any stacking or build up of the cable occurs, make sure that the first cable guide at the top of the boom root section is correctly aligned with the outside edge of the extension reel.

Clean the reel-off cable; then lubricate it with a silicone oil.



Checking The Extension Sensor Drive Voltage

1. Remove the extension reel cover.
2. Using a digital voltmeter, measure the voltage between the RED (LS1) and BLUE (LS3) wires.
3. Check that the voltage is between 4.7 and 5.3 volts.

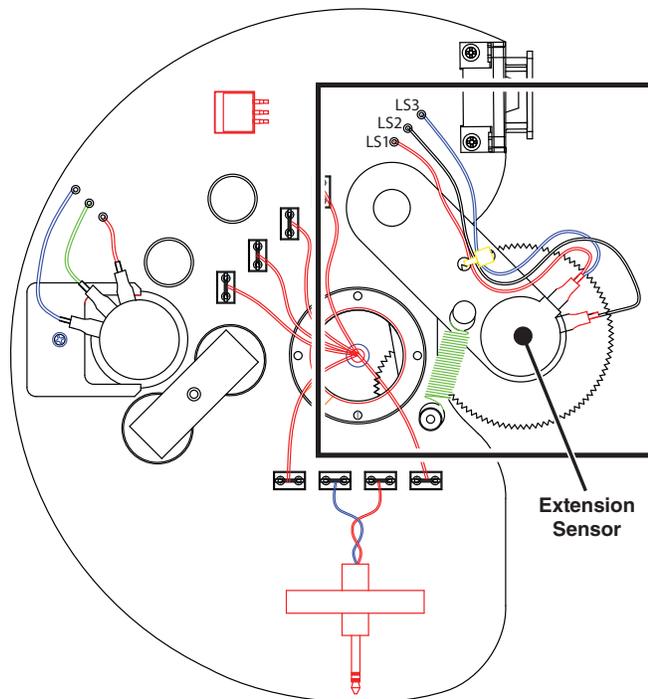
Voltages outside the range specified above will indicate an interconnection problem between the extension reel and the computer or, a short circuit within the extension reel. Check extension reel wiring within the reel and at connector J305.

Checking The Boom Extension Sensor Voltage

1. Fully retract the boom.
2. Remove the extension reel cover.
3. With a digital voltmeter, measure the voltage between the BLUE wire (LS3) and the WHITE wire (LS2).
4. With the boom fully retracted, the voltage should be between 0.1 and 0.3 volts. If the voltage is incorrect, refer to "Extension Sensor Setup" on page 28.
5. Still measuring the voltage at the same points, telescope the boom out and check that the potentiometer is operating by verifying that the voltage increases.

⚠WARNING

CHECK CAPACITY MANUAL FOR SAFE OPERATION BEFORE TELESCOPING THE BOOM.



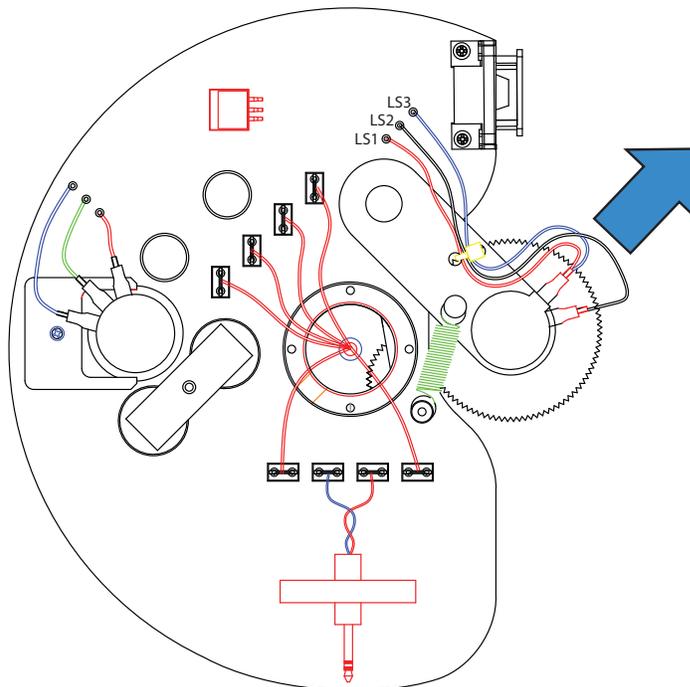
Extension Sensor Setup

The following procedures define how to reset and calibrate the extension sensor, if necessary. Before any of these procedures are used, check that the reel-off cable is layering correctly, refer to “Checking the Reel-Off Cable Layering” on page 26.

Physical Zero

It is necessary to ensure that the extension sensor potentiometer is correctly set to its minimum “zero” setting when the boom is fully retracted. This ensures that the sensor will correctly measure over the full telescoping range of the boom.

1. Fully retract the boom.
2. With the cover of the extension reel removed, disengage the main gear wheel connected to the extension sensor by pulling the sensor arm in the direction shown.



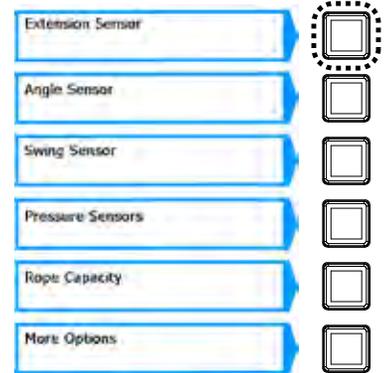
3. Turn the potentiometer until you feel some resistance indicating you are at the end. Then adjust the potentiometer until the desired reference voltage is reached.
4. Measure the voltage between LS3 and LS2.
5. Rotate the gear counterclockwise about half a turn setting the voltage to 0.2 volts. Then, carefully release the sensor arm, ensuring that the voltage remains at 0.2 volts as the gears re-engage.

Zero Calibration

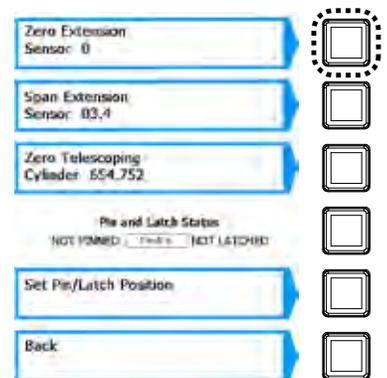
The computer must identify where the zero point of the extension sensor has been set. It is therefore necessary to calibrate the zero setting of the potentiometer.

Before continuing, ensure that the mechanical zero has been properly set. Refer to “Physical Zero” on page 28.

1. Fully retract the boom.
2. Enter calibration mode (see page 6).
3. From the calibration menu, cycle through the selections until “Extension Sensor” appears. Press the key adjacent to **Extension Sensor**.



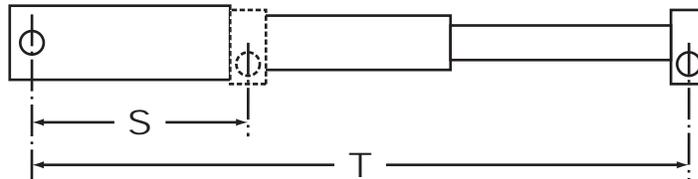
4. Ensure the boom is fully retracted and press the key adjacent to **Zero Extension Sensor** to set the extension to zero. **DO NOT PRESS THE “SPAN EXTENSION SENSOR” KEY WITH THE BOOM FULLY RETRACTED. IF THIS HAPPENS, THE MANUAL BOX WILL HAVE TO BE CONNECTED AND THE BOOM EXTENDED MANUALLY.**
5. Before exiting the command, ensure that the displayed value is between -4 and +4.



Span Calibration

The computer must be able to treat measurements of distance provided by the extension sensor. It is therefore necessary to calibrate the span of the extension potentiometer.

Before continuing, ensure that the calibration zero has been properly set. Refer to “Zero Calibration” on page 29.



With the boom still fully retracted, lower it to a horizontal position. Measure the distance from the boom pivot to the hook centerline [S].

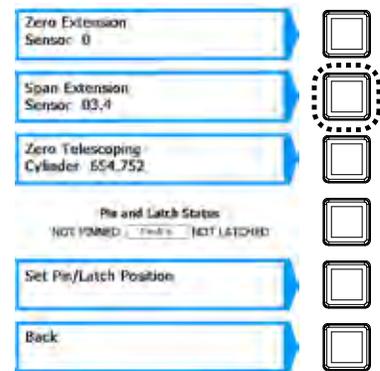
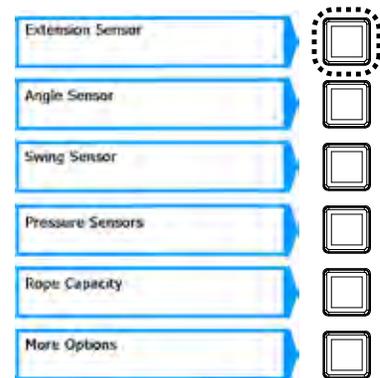
Next, fully extend the boom and measure the distance from the boom pivot to the hook centerline [T].

⚠WARNING

CHECK CAPACITY MANUAL FOR SAFE OPERATION BEFORE TELESCOPING THE BOOM.

Calculate the span by subtracting the fully retracted length from the fully extended length:
 $[T - S = \text{Span}]$.¹

1. Enter calibration mode [see page 6].
2. From the calibration menu, cycle through the selections until “Extension Sensor” appears. Press the key adjacent to **Extension Sensor**.
3. Ensure the boom is fully extended and press the key adjacent to **Span Extension Sensor**. Enter the span. Use the number entry procedure on page 3 to enter the span.
4. Exit calibration mode and go to the main working screen. Verify the extended boom length reading is correct.
5. Before exiting the menu, check that the displayed value is within ± 0.2 of the extension value calculated previously.
6. Fully retract the boom and ensure that the crane upper is set at the in-line, over front position with the house-lock engaged.



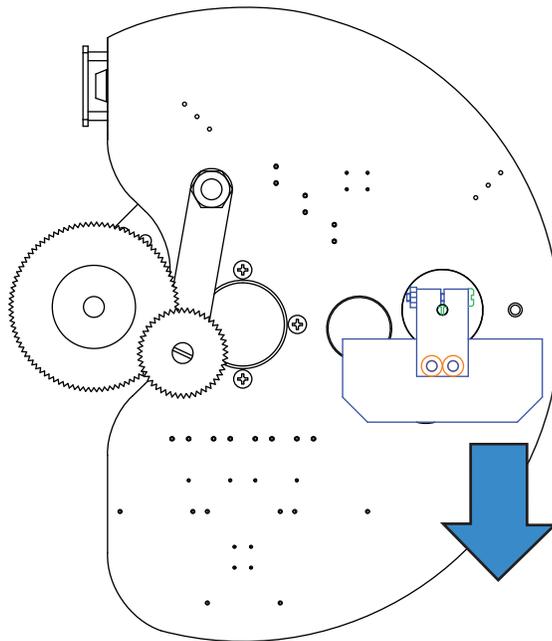
¹ An optional method for calculating the span is to refer to the crane load chart which will show the fully retracted boom length and the full extended boom length.

Checking The Angle Sensor Pendulum

The angle sensor uses a copper pendulum, mounted behind the sensor assembly. In order to stop the pendulum from swinging uncontrollably during movements of the boom, two magnets provide damping.

If problems with the angle sensor are suspected, check that the pendulum and potentiometer are operating without restriction, before continuing to check electrical operation and performing any calibration.

1. Remove the extension reel cover.
2. Locate the pendulum.
3. Push the pendulum downwards in the direction shown and ensure that it doesn't feel as if it is sticking. Some resistance of movement may be encountered as the pendulum is moved; however, this is due to the magnets that provide the damping.



4. Release the pendulum and make sure that it returns with free, but controlled movement, directly back to its original position.
5. Push the pendulum downwards a few more times, checking that it returns, each time, to its starting position.

IMPORTANT!

IF ANY “STICKING” OF THE PENDULUM IS ENCOUNTERED WHILE PERFORMING THE ABOVE CHECKS, ENSURE THAT THERE ARE NO WIRES TOUCHING THE PENDULUM, OR THAT OTHER OBVIOUS PROBLEMS ARE PRESENT. IF NOT, IT WILL BE NECESSARY TO REPLACE THE SENSOR ASSEMBLY.

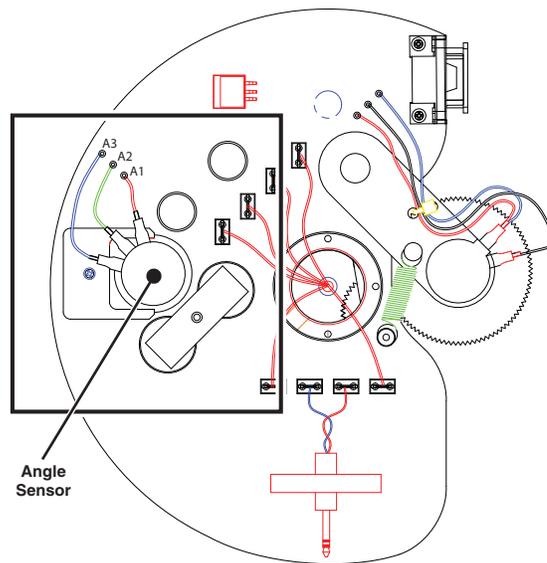
Checking The Angle Sensor Drive Voltage

1. Remove the extension reel cover.
2. Using a digital voltmeter, measure the voltage between the RED [A1] and BLUE [A3] wires at the terminal block mounted on the sensor baseplate assembly.
3. Check that the voltage is between 4.7 and 5.3 volts.

Voltages outside the range specified above will indicate an interconnection problem between the extension reel and the computer or, a short circuit within the extension reel. Check extension reel wiring within the reel and at the boom foot base connector.

Checking The Angle Sensor Voltage

1. Using an inclinometer for verification, place the main boom at a 0° [zero] angle; then remove the extension reel cover.
2. With a digital voltmeter, measure the voltage between the BLUE wire [A3] and the GREEN wire [A2]. With the boom horizontal, the voltage should be between 0.3 and 0.5 volts. If the voltage is incorrect, refer to “Angle Sensor Setup” on this page.
3. Still measuring the voltage at the same points, move the exposed side of the angle sensor pendulum downwards, and check that the potentiometer is operating by verifying that the voltage increases.
4. Check that the pendulum moves freely, and when released, falls smoothly back to the original 0° [zero] voltage reading, as measured previously.



Angle Sensor Setup

The following procedures define how to reset and calibrate the angle sensor.

Physical Zero

It may be necessary to ensure that the angle sensor potentiometer is correctly set to its physical “zero” setting with the boom at 0° [ZERO]. This ensures that the sensor will correctly measure the full angle range of the boom.

1. Using an inclinometer, set the boom to 0° [ZERO].
2. Loosen the securing screw just enough to allow the sensor potentiometer to be turned by hand. Do not remove the screw and do not put pressure on the terminals exiting the sensor.
3. Measuring the voltage between A3 and A2. Carefully rotate the potentiometer until the voltage measures 0.4 volts. Rotating the sensor counterclockwise will increase the voltage. Rotating clockwise will reduce the voltage. Only fine adjustments are required. Do not touch the pendulum hanging behind the sensor assembly, as this will affect the reading.

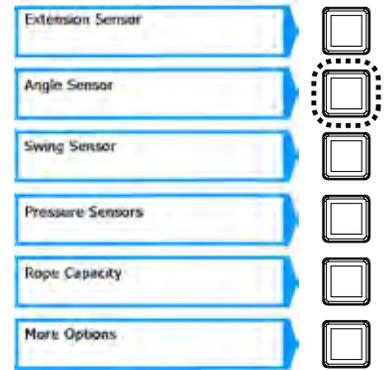
4. Tighten the securing screws and check that the voltage remains at 0.4 volts.

Zero Calibration

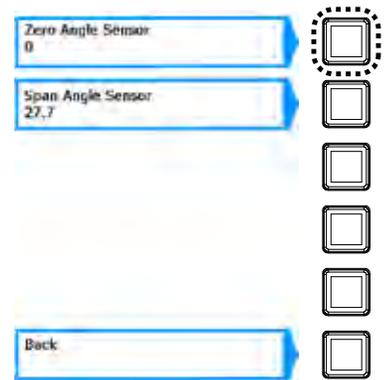
The computer must be able to identify where the ZERO point of the angle sensor has been set. It is, therefore, necessary to calibrate the zero setting of the potentiometer.

Before continuing, make sure that the mechanical (physical) zero has been properly set. Refer to "Physical Zero" on page 32.

1. Using an inclinometer, set the boom to 0° (zero).
2. Enter calibration mode (see page 6).
3. From the calibration menu, cycle through the selections until "Angle Sensor" appears. Press the key adjacent to **Angle Sensor**.



4. Press the key adjacent to **Zero Angle Sensor** to set the angle to zero.
5. Before exiting the command, check that the displayed value is between -4 and +4.



Span Calibration

The computer must be able to treat measurements of the angle provided by the angle sensor. It is therefore necessary to calibrate the SPAN of the angle potentiometer.

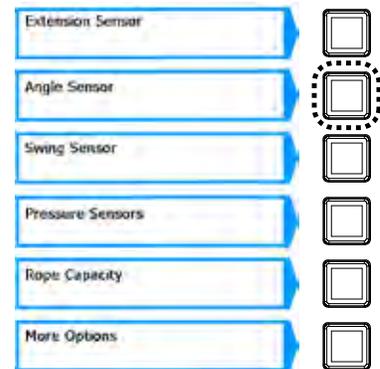
Before continuing, ensure that the calibration zero has been properly set. Refer to Zero Calibration on page 33.

1. Boom up to a high angle (at least 70°) and measure the angle with an inclinometer.

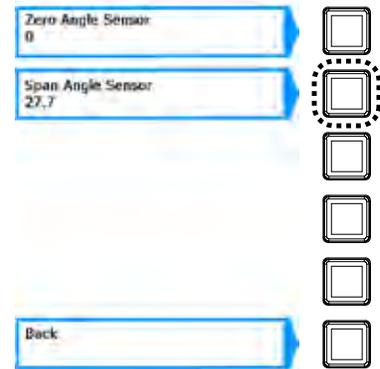
⚠WARNING

CHECK CAPACITY MANUAL FOR SAFE OPERATION BEFORE RAISING THE BOOM.

2. Enter calibration mode (see page 6).
3. From the calibration menu, cycle through the selections until “Angle Sensor” appears. Press the key adjacent to **Angle Sensor**.



4. Press the key adjacent to **Span Angle Sensor** to enter a measured angle. Use the number entry procedure on page 3 to enter the angle.



IMPORTANT!

THE REQUIRED ACCURACY OF MEASURED ANGLES IS WITHIN 0.2°.

WHEN TAKING BOOM ANGLE MEASUREMENTS; ALWAYS USE A GOOD QUALITY INCLINOMETER. MANY INCLINOMETERS ARE ONLY ACCURATE AT 0° (LEVEL). ENSURE THAT A RELIABLE POSITION ON THE TOP OF THE BOOM IS USED TO MEASURE THE ANGLE AND THAT THE INCLINOMETER WILL PROVIDE AN ACCURATE READING AT 0° AND AT 70°.

5. Before exiting the command, check that the displayed value is between -0.1° and +0.1°.

Extension Reel Replaceable Parts

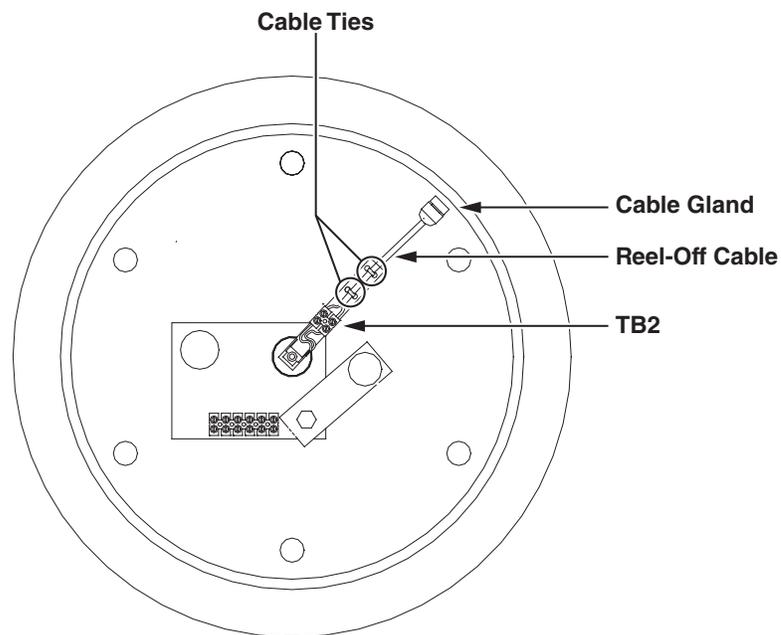
The extension reel is field-serviceable in every respect except for the spring chamber/extension reel surface and shaft assembly. Failure of the recoil spring, damage to the shaft or reel surface and side plates requires complete replacement of the extension reel.

The following parts of the extension reel, are field-replaceable:

- Extension/reel-off cable assy
- Slip-ring assembly
- Sensor baseplate assembly
- Cable tail assembly (signal cable)
- Cover

Extension Reel-Off Cable

The extension reel-off cable, running from the extension reel to the main boom head, carries the Anti Two-Block signal from the switches at the main boom head, aux head and erected jib/fly. The cable is made from stainless steel wire and a durable outer sheath. Damage to the cable will often result in bad Two-Block signals or bad measurement of boom extension. If the cable has been broken or damaged in any way, it can be field-replaced.



Removal

1. Fully retract and lower the boom. Then, disconnect the reel-off cable from the ATB switch or connector.
2. Gripping the cable firmly, release it from the tie-off post.
3. Continue to grip the cable firmly while allowing it to fully wind back onto the extension reel.
4. Remove the extension reel cover.
5. Cut the two (2) tie-wraps that secure the extension reel-off cable to the slip-ring support arm.
6. Unscrew the extension reel-off cable from the terminal block on the slip-ring support arm.
7. Loosen the gray cable gland mounted on the cheekplate.

8. Pull the existing extension reel-off cable out through the cable gland.

Installation

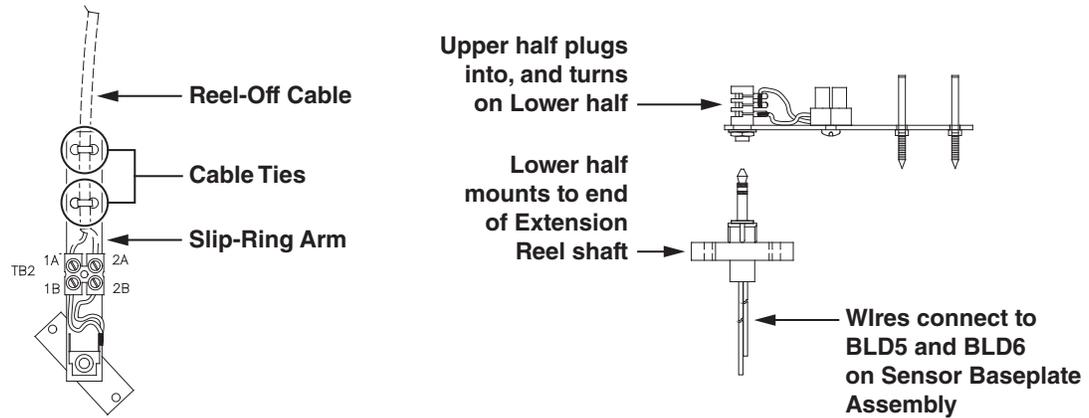
1. Loosen the strain relief on the cheekplate and feed the extension reel-off cable through the wall of the cheekplate. Leave enough slack to work easily with the cable.
2. If not already stripped, remove 1" of the outer jacket of the cable with a sharp knife.
3. Unravel the stainless steel braid and twist it into a single wire.
4. Remove 1/4" insulation from the center wire. The insulation bonded to the center wire is difficult to remove. Remove small increments about 0.1" at a time with wire strippers.
5. Connect the extension reel-off cable to TB2 on the arm of the slip-ring. The braided wire connects to the black wire and the center core connects to the brown wire. Using two cable ties, tie the cable to the arm of the slip-ring.
6. Secure the extension reel-off cable to the arm of the slip-ring with 2 tie-wraps.
7. Adjust the cable to bend slightly from the strain relief to the slip-ring. Rotate the extension reel. Ensure that the path of the new cable is unimpeded; then, tighten the strain relief.
8. Wind the extension reel-off cable onto the extension reel in a single layer.
9. Set pre-tension (5 turns counterclockwise). Thread the extension reel off-cable through the cable guides. Attach the cable to the boom tie-off-post and connect it to the ATB switch.
10. Refer to "Extension Sensor Setup" on page 28 to set the potentiometer zero. Recalibration of the extension span should not be necessary.
11. Fully telescope the boom in and out at least twice, ensuring that the reel-off cable remains in a single flat layer on the drum surface and the length display on the display console is accurate with a fully extended or fully retracted boom. Any stacking of the cable on the extension reel surface will cause measurement errors. If this is the case, it may be necessary to check that the first cable guide aligns correctly with the outside edge of the extension reel surface.
12. Reinstall the cover of the extension reel, ensuring that the "O" ring on the inside of the extension reel is intact.

Slip-Ring Assembly

The main purpose of the slip-ring assembly is to provide an electrical path for the feed and switch signal return, between the Two-Block switch and the system computer.

It is unlikely that the slip-ring assembly should ever require repair or replacement. If such an event arises, however, both the upper and lower halves of the slip-ring assembly must be replaced at the same time.

Failure of the slip-ring assembly will most likely result in a continuous Two-Block alarm. For information on testing and checking the slip-ring assembly, refer to “Anti-Two-Block Function” on page 42.



Removal

1. Remove the extension reel cover.
2. Holding the reel-off cable on the arm of the slip-ring, cut the tie wraps.
3. Unscrew the reel-off cable from TB2 on the arm of the slip-ring.
4. Unscrew both Phillips screws that hold the lower half of the slip-ring on the shaft; remove the slip-ring.
5. Disconnect the two wires connecting the lower half of the slip-ring assembly at BLD5 and BLD6 on the sensor baseplate assembly.

Installation

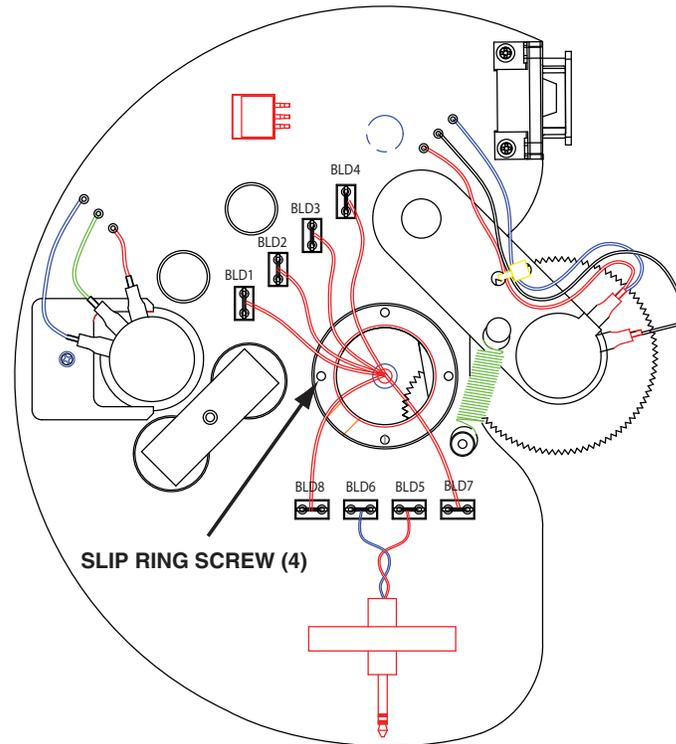
The new slip-ring assembly is pre-lubricated with grease. Do not wipe off lubrication.

1. Attach the brown slip-ring wire from the lower half of the new slip-ring to BLD6 on the sensor baseplate assembly. Make sure that the brown signal wire is also correctly connected to BLD8.
2. Attach the black (or white) slip-ring wire from the lower half of the new slip-ring to BLD5 on the sensor baseplate assembly. Make sure that the black signal cable wire is also correctly connected to BLD7.
3. Screw the bottom half of the slip-ring to the shaft with the two Phillips screws, making sure that wires exiting through the center of the shaft are not trapped.
4. Connect the extension reel-off cable to TB2 on the arm of the slip-ring. The braided shield connects to the slip-ring TB2 black wire and the center of the cable connects to the slip-ring TB2 brown wire.
5. Secure the extension reel-off cable to the arm of the slip-ring with two cable ties.
6. Ensure that the slip-ring is plugged in all the way.
7. Replace the extension reel cover.

Sensor Baseplate Assembly

The sensor baseplate assembly supports both the extension and angle sensors and provides interconnection between the sensors, the Two-Block switch signal to the slip-ring, and the signal cable to the system.

Electrical or mechanical failure of either the angle sensor or the extension sensor potentiometers may not be field-repaired. In the event of failure of either of these items, the whole sensor baseplate assembly must be replaced.

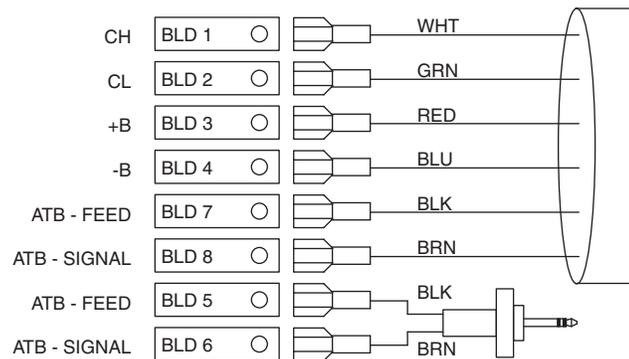


Removal

1. Remove the cover on the extension reel.
2. Disconnect the signal cable wires to BLD1 through BLD4, BLD7, and BLD8.
3. Remove the four (4) screws holding the slip-ring to the mounting ring of the sensor assembly.
4. Using a 5/32" Allen wrench, loosen the set-screw that holds the baseplate on the shaft.
5. Remove the sensor assembly.

Installation

1. Place the boom in a horizontal position.
2. Feed the wires coming out of the main shaft through the mounting collar on the sensor assembly.
3. While pulling both extension sensor gears out, against the spring, slide the sensor assembly onto the shaft until the top of the shaft aligns with the top of the mounting collar. Align the top edge of the assembly parallel with the boom.
4. Tighten the set-screw and release the gears allowing them to mesh with the extension reel spline.
5. Reinstall the slip-ring assembly to the baseplate of the sensor assembly using four (4) screws.
6. Route and reconnect the wires, as indicated.



Sensor Assembly Terminal Block Wiring						
Terminal	BLD1	BLD2	BLD3	BLD4	BLD7	BLD8
Wire Color	White	Green	Red	Blue	Black	Brown
Signal	Can High	Can Low	Battery Power +12V	Battery Ground 0V	ATB Feed	ATB Signal

IMPORTANT!

ENSURE THAT THE WIRES LAY FLAT. ENSURE THAT THERE WILL BE ENOUGH SPACE TO ALLOW THE SLIP-RING ARM TO FREELY ROTATE.

7. Check the wiring and then follow the procedures to set up both the angle and extension sensors.

Signal Cable Assembly

The signal cable assembly provides interconnection between the extension reel sensors, the Two-Block switch and the system computer.

Removal [from boom]

1. Fully lower and retract the boom.
2. Disconnect the extension reel cable from the anti two-block switch.
3. Gripping the extension reel cable firmly, remove it from the tie-off post.
4. Maintain a firm hold on the extension reel cable as the cable unwinds back onto the reel.
5. Secure the end of the extension reel cable to prevent unwinding.
6. Disconnect the signal cable at the distal end.

- Unbolt the extension reel from the crane with a wrench.

Removal (from extension reel)

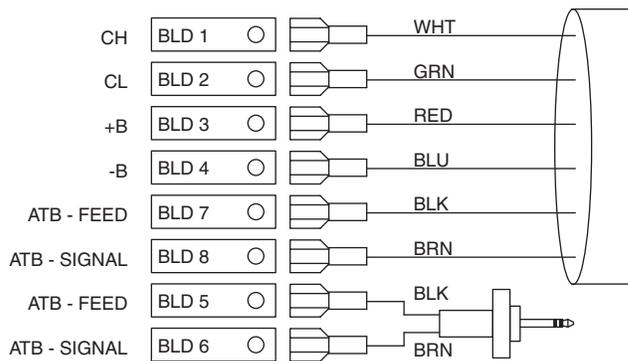
- Remove the cover from the extension reel.
- Remove the slip-ring on the baseplate of the sensor assembly.
- Disconnect wires from BLD1 through BLD4, BLD7, and BLD8.
- To protect the sensors within the extension reel, use two screws to temporarily reattach the cover of the extension reel.
- Turn over the extension reel with cover attached, exposing the back of the device.
- With the wires still disconnected, pull the SIGNAL CABLE out of the main shaft in the center of the reel. This cable has a strain-relief encircled with an o-ring, creating a tight fit that seals out water.

IMPORTANT!

IF IT IS DIFFICULT TO REMOVE THE CABLE, USE THE INSERTION/EXTRACTION TOOL FROM THE FRONT OF THE EXTENSION REEL TO RELEASE THE CABLE.

Installation

- Unpack the new signal cable and ensure that the o-ring on the strain-relief is greased.
- With the back of the extension reel still exposed, insert the end of the signal cable with the o-ring into the mounting plate and down the shaft in the center of the reel.
- Seat the strain-relief, with attached o-ring, as follows, using the tool provided in the kit.
- Bend the cable to the side. Position the hollowed-out section of the tool on the strain-relief plug at the top of the shaft.
- With a hammer, gently tap the top of the tool forcing the strain-relief into proper position in the shaft. Continue to tap gently until the strain-relief plug will go no further.
- Turn over the extension reel and remove the cover.
- Route and reconnect up the wires, as indicated.



Sensor Assembly Terminal Block Wiring						
Terminal	BLD1	BLD2	BLD3	BLD4	BLD7	BLD8
Wire Color	White	Green	Red	Blue	Black	Brown
Signal	Can High	Can Low	Battery Power +12V	Battery Ground 0V	ATB Feed	ATB Signal

8. Reinstall the slip-ring assembly to the baseplate of the sensor assembly using four (4) screws.

IMPORTANT!

ENSURE THAT THE WIRES LAY FLAT AND TOWARD THE TERMINAL CONNECTORS. ENSURE THAT THERE WILL BE ENOUGH SPACE TO CLEAR THE WIRES WHEN THE ARM OF THE SLIP-RING ROTATES.

9. Replace the cover on the extension reel; reinstall the extension reel.

Anti Two-Block (ATB) Function

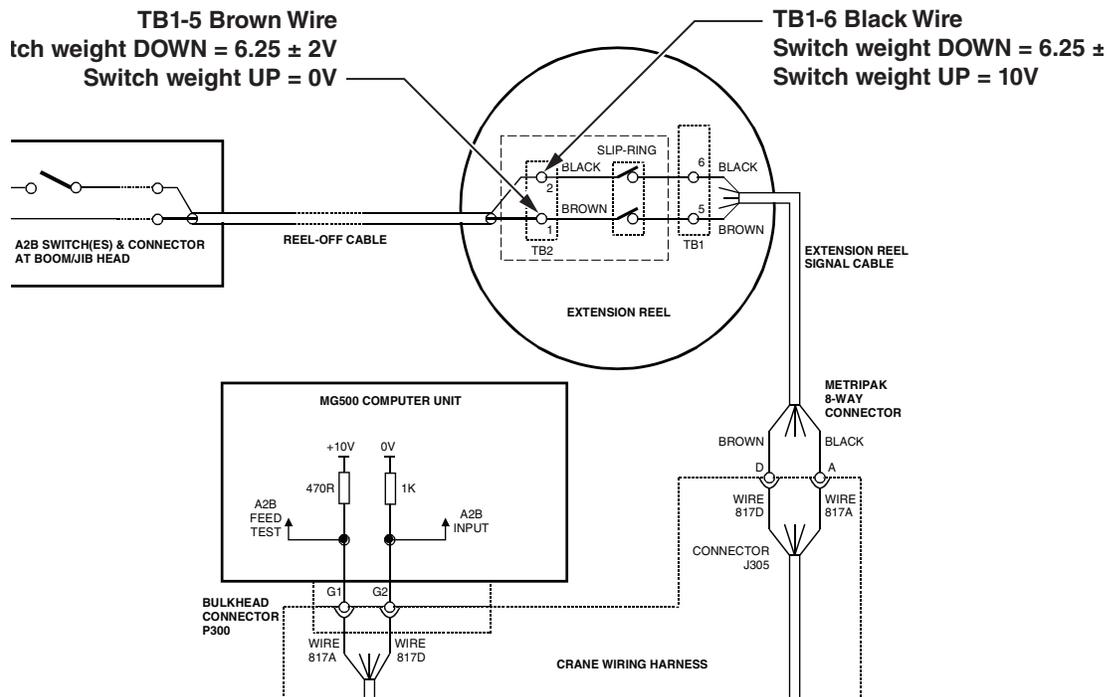
Anti Two-Block Function Overview

This section describes fault diagnoses of the ATB detection circuit. For details of function kickouts (including the anti two-block kickout), refer to "Power, Kickout, and Boom Mode Outputs" on page 45.

The computer supplies a protected positive feed to the ATB switches at the boom/jib head via the extension reel signal cable, slip-ring, and extension reel-off cable. With the ATB weight hanging freely on the switch(es), the switch contact is closed and the signal return to the computer is high (6.25 volts). When the weight is lifted by the hook block, the switch contact is opened, and the computer will sense a low signal input (0 volts) from the ATB signal return.

Since the computer checks the protected feed voltage internally, the system is capable of detecting a short circuit of the feed (or the ATB signal return when the switch is closed) to the crane chassis. Fault codes are defined in "Problem Finder" on page 9.

The ATB detection circuit is probably the most susceptible part of the system, since it is carried through so many of the system components. Often, most problems with this circuit may be identified through inspection of cables, switches, and the extension reel. Damage to these parts may result in continuous or intermittent ATB alarms.

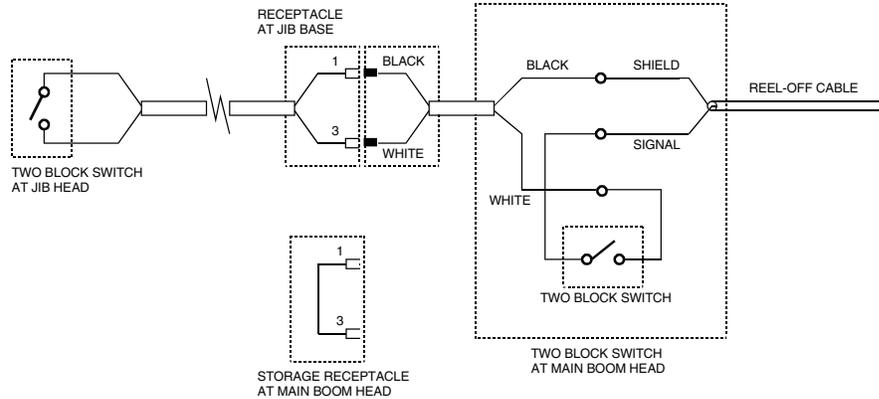


ATB Switch Configurations

This section details wiring schemes for ATB switches.

Rectangular Plug-In Connectors

Cranes fitted with rectangular style plug-in connectors do not have a MAIN/BOTH/JIB selector switch in the main boom head ATB switch.



Checking The Extension Reel-Off Cable

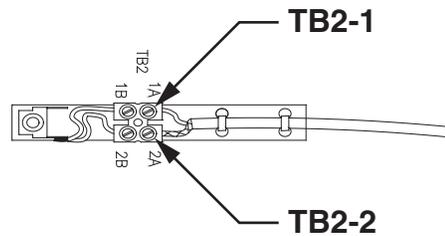
The outer braid of the cable carries the ATB feed to the switches. If the cable sheath is damaged, this may cause a short circuit to the boom/chassis. The same fault will be indicated if the ATB switch is closed and the inner core of the cable is shorted to chassis at some point in the wiring.

- Carefully inspect the reel-off cable for wear.
- Check for signs of damage to the outer sheath of the cable.
- Check for any signs of severe “kinking” or crushing of the cable.

Checking The ATB Circuit

Before continuing, ensure that connectors are correctly connected to the ATB switches at the boom head/jib.

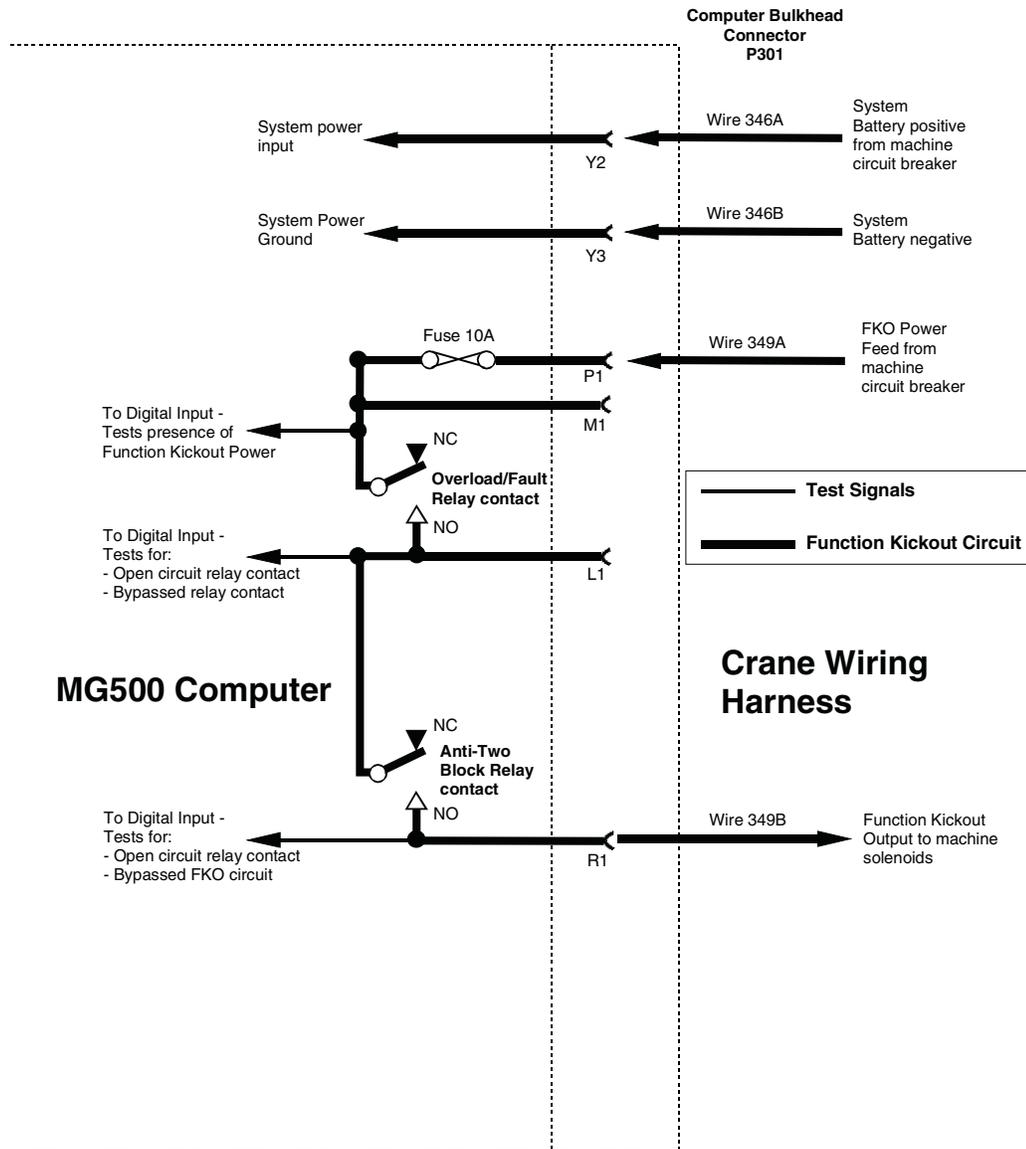
1. Remove the extension reel cover.
2. Disconnect the slip-ring arm from the plug by pulling it away from the center of the reel.
3. Close the ATB switch at the boom head by suspending the weight from it or pulling on the chain.
4. Measure the resistance between TB2-1 & TB2-2 terminal connections on the sensor arm.



5. With the ATB switch closed, the resistance should be less than 300 ohms. If not, this suggests that the reel-off cable, ATB switch, or one of the boom head connectors has an open circuit.
6. Open the ATB switch at the boom head by lifting the weight.
7. Measure the resistance between TB2-1 & TB2-2 terminal connections on the sensor arm.
8. With the ATB switch open, the resistance should be greater than 10,000 ohms. If not, this suggests that the reel-off cable, ATB switch, or one of the boom head connectors has a short circuit.

Power, Kickout, and Boom Mode Outputs

This section provides schematic outlines of outputs from the computer and is provided for information only. Since most of these functions are contained within the computer design and crane wiring harness, only limited fault diagnosis may be carried out. The FKO fuse (FS2) is described in "Computer Unit" on page 17.



Swing Sensor

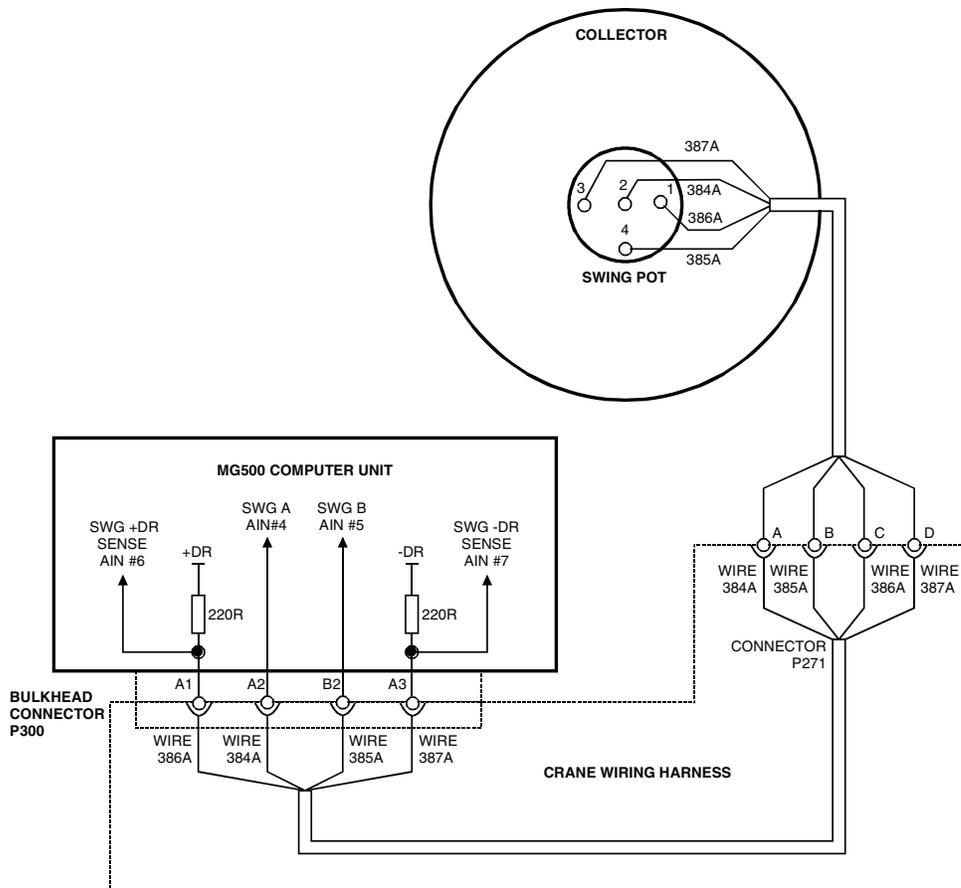
Swing Sensor Overview

The swing sensor measures the angle of the upper structure of the crane relative to its carrier. This angle is then used to select capacity charts and operator swing alarms/working area alarms.

In the event that the swing sensor fails, the computer will be unable to select a valid capacity chart.

For fault diagnosis, the swing sensor may be accessed by removing the cover of the collector at the cranes swing center.

For swing sensor replacement procedures, consult factory service.



Checking the Swing Sensor Drive Voltage

1. Remove the collector ring cover to expose the swing sensor.
2. With the system power turned on, measure the voltage between terminal 1 of the swing sensor and crane ground. The voltage should be between 4.4 and 4.8 volts.
3. Measure the voltage between Terminal 3 of the swing sensor and crane ground. The voltage should be between 0.2 and 0.5 volts.

Voltages outside of those shown in steps 2 and 3 indicate a problem with the swing sensor or cabling connections. If voltages are incorrect, proceed to "Checking the Swing Sensor Resistance" on page 47. If voltages are correct, proceed to "Checking the Swing Sensor Output Voltage" on page 47.

Checking The Swing Sensor Output Voltage

1. Remove the collector ring cover to expose the swing sensor.
2. With the system power turned on, measure the voltage between Terminal 2 of the swing sensor and crane ground. The voltage should be between 0.2 and 4.8 volts.
3. Measure the voltage between Terminal 4 of the swing sensor and crane ground. The voltage should be between 0.2 and 4.8 volts.

Voltages outside of those shown in steps 2 and 3 indicate a problem with the swing sensor or cabling connections. If voltages are incorrect, proceed to “Checking the Swing Sensor Resistance” on this page.

Checking The Swing Sensor Resistance

1. Disconnect the connector P271 (behind the collector ring).
2. Measure the resistance between pins C and D of the connector on the swing sensor side. The resistance should be between 2200 and 2800 ohms.
3. Measure the resistance between pins A and B of the connector on the swing sensor side. The resistance should be between 1800 and 2300 ohms.

IMPORTANT!

RESISTANCES OUTSIDE OF THOSE SHOWN IN STEPS 2 AND 3 INDICATE A PROBLEM WITH THE SWING SENSOR OR ASSOCIATED CABLE CONNECTIONS. IF RESISTANCES ARE INCORRECT, REPLACE THE SWING SENSOR AND ITS CABLE.

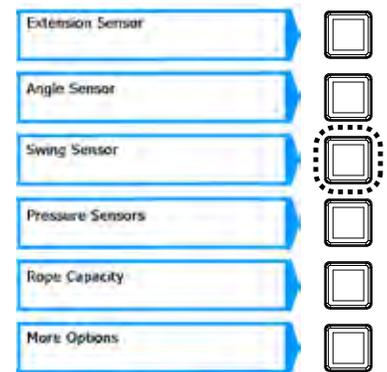
Swing Sensor Setup And Checks

The following procedures may be used to check or setup the SWING SENSOR. Only two setup operations are required (ZERO and DIRECTION). Unlike other system sensors, the swing sensor requires no span calibration to operate. Span is automatically calculated by the computer.

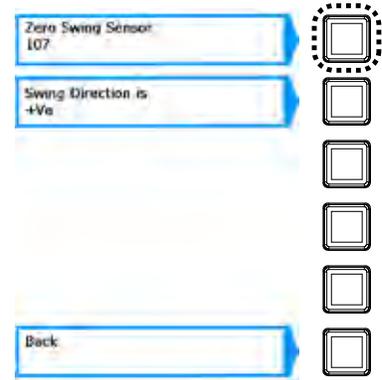
Checking and Setting Zero

The 0° [zero] angle of the upper structure should be set with the house-lock engaged over front for all types of cranes. Before continuing, ensure that the upper structure is positioned over front and the house-lock is engaged.

1. Enter calibration mode (see page 6).
2. From the calibration menu, cycle through the selections until Swing Sensor appears. Press the key adjacent to **Swing Sensor**.

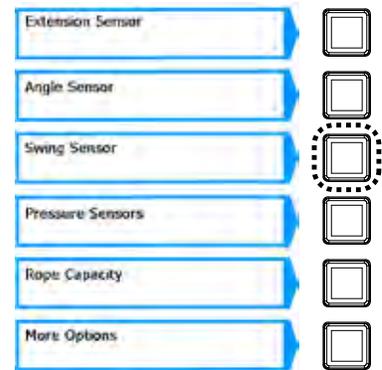


- Position the boom over the front to the machine with the house lock set and press the key adjacent to **Zero Swing Sensor**. Rotate the boom clockwise and observe the reading on the screen. If the numbers decrease, change the swing direction by pressing the key adjacent to **Swing Direction**.
- Check that the angle value displayed is between -0.5° and $+0.5^\circ$. If not, reset the zero by pressing the zero key.

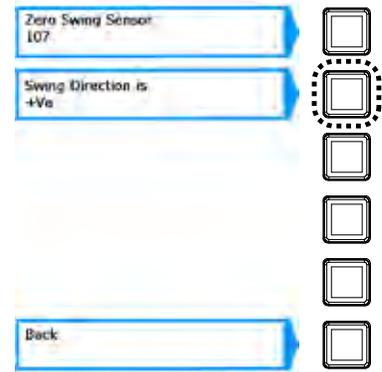


Checking and Setting Direction

- Enter calibration mode (see page 6).
- From the calibration menu, cycle through the selections until Swing Sensor appears. Press the key adjacent to **Swing Sensor**.



- Remove the house-lock and swing to the right. Check that the angle value displayed increases from zero. If not, the displayed value will immediately jump to over 350° and continue counting down as the crane upper is swung to the right. If this is the case, press the key adjacent to **Swing Direction** to reverse the calibrated direction of the sensor.





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