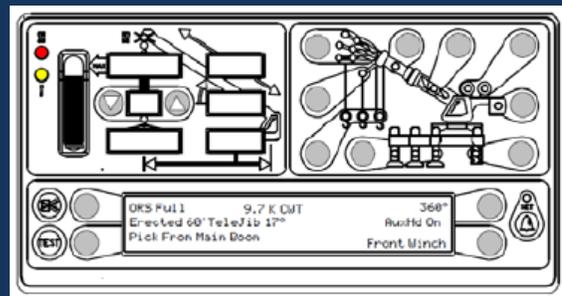




RCI 510/400 Telescopic Boom Cranes



Service Manual

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Fault Diagnostic Procedures

Faults in the RCI 510/400 System are detected at start-up with an automatic self-test that lasts 3 seconds. During normal operation, a self-test can be initiated at any time by pressing the red TEST button on the front left panel of the display.

Fault conditions in external sensors are detected without the need for a system self-test.

Faults detected in the system during a self-test are identified on the display as follows:

- The word “FAULT” will display in the information area.
- The RED INDICATOR will illuminate.
- The AUDIBLE ALARM will sound.

Faults occurring in the system can be diagnosed using the display.

1. Press and hold the TEST button to initiate the self-test to identify any faults.
2. Continue to press the TEST button. Following the self-test, faults found will be identified on the display screen and will remain visible as long as the operator continues to hold the TEST button.

Fault Codes

Fault information will appear on the screen in the following four groups.

- Group A Sensor Faults
- Group B I/O Faults
- Group C Memory Faults
- Group D General Faults

When a fault is detected by the system, a number will appear under one or more of the four group headings A through D. This number will correspond to one or more of the fault diagnostic numbers. Determine the specific fault by looking at the appropriate code in the fault interpretation table.

GROUP "A" ANALOG SENSORS		
CODE		
000		NO FAULTS
001	SENSOR 0	PISTON PRESSURE TRANSDUCER
002	SENSOR 1	ROD SIDE PRESSURE TRANSDUCER
004	SENSOR 2	EXTENSION SENSOR
008	SENSOR 3	BOOM ANGLE SENSOR
016	SENSOR 4	S'STRUCTURE ANGLE SENSOR
032	SENSOR 5	SWING POTENTIOMETER "A"
064	SENSOR 6	SWING POTENTIOMETER "B"

GROUP "B" INPUTS AND OUTPUTS		
CODE		
00		NO FAULTS
01	FAULT 1	DIGITAL INPUT AND OUTPUT
02	FAULT 2	ANALOG INPUT AND OUTPUT
04	FAULT 4	DISPLAY UNIT

GROUP "C" MEMORY		
CODE		
00		NO FAULTS
01	FAULT 1	EXECUTIVE ROM
02	FAULT 2	DUTY ROM
04	FAULT 3	SCRATCHPAD RAM
08	FAULT 4	PERSONALITY ROM

GROUP "D" GENERAL		
CODE		
00		NO FAULTS
01	FAULT 1	NO DUTY FOUND
02	FAULT 2	CURRENT DUTY BAD
04	FAULT 4	ROPE OR RAM DIMENSION MISSING
08	FAULT 8	FLY NOT CALIBRATED

Examples Of Fault Codes

FAULT	DISPLAY AAA BB CC DD	DESCRIPTION
0	000 00 00 00	No Faults Detected
1	001 00 00 00	Piston Pressure Transducer
2	002 00 00 00	Rod Pressure Transducer
3	003 00 00 00	Piston Pressure Transducer Rod Pressure Transducer
4	004 00 00 00	Extension Sensor
5	005 00 00 00	Piston Pressure Transducer Extension Sensor
6	006 00 00 00	Rod Pressure Transducer Extension Sensor
7	007 00 00 00	Piston Pressure Transducer Rod Pressure Transducer Extension Sensor
8	008 00 00 00	Boom Angle Sensor
9	009 00 00 00	Piston Pressure Transducer Boom Angle Sensor
10	010 00 00 00	Boom Angle Sensor Rod Pressure Transducer
11	011 00 00 00	Boom Angle Sensor Piston Pressure Transducer Rod Pressure Transducer
32	032 00 00 00	Swing Potentiometer "A"
64	064 00 00 00	Swing Potentiometer "B"
99	096 00 00 00	Swing Potentiometer "A" Swing Potentiometer "B"
127	127 00 00 00	All analog sensors*

*This fault condition is usually the result of analog drive voltage failure, which supplies voltage for all sensors. It may be due to power supply failure or damage to the cables. Run a power supply voltage check before checking individual sensors.

Voltage Checks

The computer unit contains two boards: the processor board and the termination board. All of the cables from the various sensors and the display are connected to the termination board.

Input Power

The computer operates from an input voltage range of 9-36 Volts DC. This input voltage is measured across the B+ and B- terminals on the termination board and correspond to the battery voltage of the crane. At voltages outside this range, the system will power down until correct voltage is restored. If input power is not within these limits, check the batteries and/or alternator before servicing the computer.

Internal Power Supplies

The computer generates its own internal power from the incoming battery voltage.

This can be monitored at the test points inside the computer adjacent to the fuses and battery input terminals. To monitor the internal power supplies, use a digital voltmeter set to the appropriate DC voltage range.

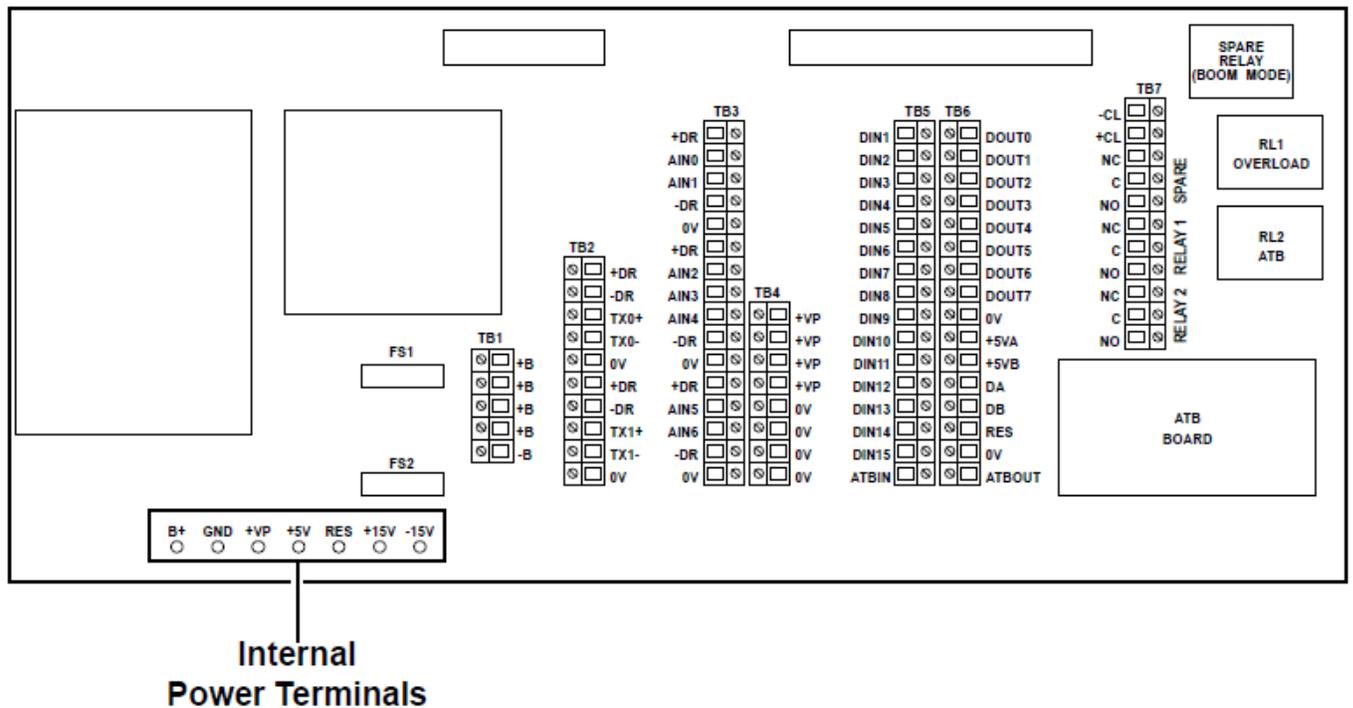
Connect the black (-ve) lead to GND and connect the red (+ve) lead in turn to:

+15V +/- 0.1

-15V +/- 0.1

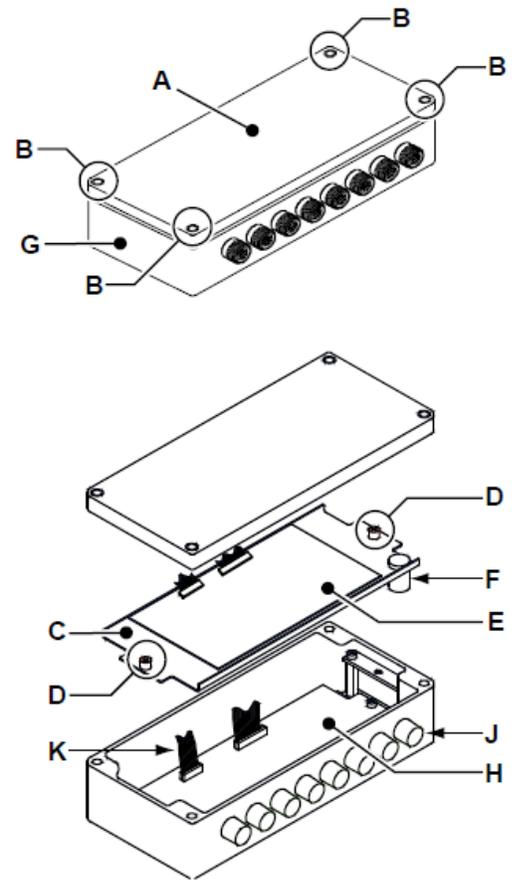
+5V +/- 0.1

If the voltages are out of range, it may be necessary to replace the computer.



The Processor Board and the Termination Board

1. Remove the four screws [B] that secure the lid [A] to the computer box [G] and remove the lid. The lid is not hinged. Do not allow the lid to slide off the box.
2. Below the lid is the processor board [E] which contains the microprocessor and its related components. This unit is held in place by two screws [D] located on either side of the processor board mounting plate [C]. The processor board is connected to the termination board [H] by two ribbon cables [K] that carry signals to and from the termination board. All of the cables from the various sensors and the display console connect to the termination board via the glands [J] in the wall of the box. The key switch [F] control three wires that connect the processor board to the termination board.
3. To check voltages on the Termination Board, remove the two screws located at the left and right of the main computer backing plate and swing the assembly up. Take care not to damage the ribbon cables. These ribbon cables must remain connected to the Processor Board for voltage checks.



Checking Analog Drive Voltage

1. Access the termination board.
2. With the power on, use a digital voltmeter set to DC, place the negative lead on any -DR (-Drive) terminal of the analog input group and place the positive lead on any +DR (+Drive) terminal. The voltage should be 5.25 ± 0.1 volts.
3. If the analog drive voltage is not within this range, disconnect all of the external sensor cables, including pressure transducers, 1 through 5.
4. Recheck the analog drive voltage. If the voltage is still out of range, the processor board will need to be replaced. If the voltage is within range, reconnect each cable, one at a time, checking the analog drive voltage after each cable is connected.
5. If the analog drive voltage goes out of range after reconnecting any one of the sensors, it is probable the wiring to the sensor is grounded or the sensor itself is faulty. Check all wires and the sensor itself and repair or replace, as required.

NOTE: *Faults in any cable or sensor can cause the analog drive voltage to be faulty.*

Pressure Channel Fault Guide Functional Tests

Pressure Sensors

A fault in one channel can cause an apparent fault in the other channel. It is necessary to test both channels and both transducers together in order to determine which sensor is at fault.

1. Access the calibration routine by simultaneously pressing and holding the ALARM SET and the TEST keys for several seconds.
2. Enter the security code, an audible alarm will sound.
3. Press the “A” or “B” button to get to the 03 Zero Sensor and then press the “C” button.
4. Press the “A” or “B” button to select TX 0 (pressure sensor piston side). View sensor and bits.
5. With the boom in the rest or the boom hoist cylinder fully retracted, relieve all pressure from both sensors. With no pressure, the upper display should indicate 0 ± 20 bits.
6. Press the “A” or “B” button to select TX 1 (pressure sensor rod side). With no pressure in the cylinder, the upper display should 0 ± 20 bits.
7. If the transducers were disconnected in step 5, tighten the fittings. With the boom fully retracted, raise the boom to a 60° angle.
8. Access the Zero of TX 0, the upper display should read 200 ± 100 bits.
9. Access the Zero of TX 1, the upper display should read 5 ± 25 bits.
10. Lower the boom down. As the boom is lowered, the displayed bits of TX 1 should increase.
11. Place the retracted boom at a 60° angle. Access the Zero of TX 0 and extend the boom. As the boom is extended, the displayed bits of TX 0 should increase. When the boom is fully extended, the display should read 400 ± 100 bits for a three-section boom and 600 ± 100 bits for a four-section boom.

The values listed are nominal values. The actual values will differ according to how the crane is equipped. A three-section boom will show a smaller value on TX 0 under the same condition as a four-section boom. Additional equipment on the main boom, such as stowed fly, auxiliary head sheaves, and hook blocks will give a higher value than the main boom alone.

If any value is out of range, contact your distributor or factory service department before replacing a pressure transducer.

12. Press the “D” button to exit.

If the previous functional test indicates faults in the pressure channels, proceed with Power Supply Tests and the test for resistance of the bridge of the pressure transducers.

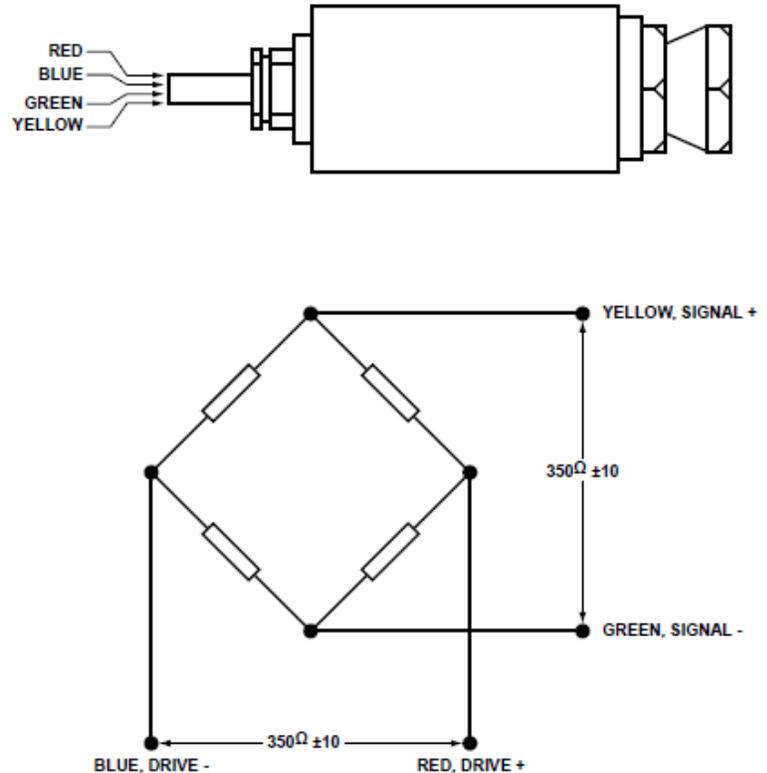
Pressure Transducer Resistance Measurement

The pressure transducer is a balanced bridge composed of strain gauges bonded to a flexible diaphragm. Perform the following resistance tests to establish the viability of the pressure transducer.

Piston Pressure Transducer

Place the boom in rest (truck drive) or in its lower position (RT's) and relieve all pressure to atmosphere on both transducers.

1. With the power to the computer of, disconnect the piston pressure transducer from the terminal blocks +DR, -DR, TXO+ and TXO- within the computer.
2. With the Voltmeter set to Ohms, measure the resistance between the red and blue wires. The resistance should be $350\Omega \pm 10$.
3. With the Voltmeter set to Ohms, measure the resistance between the yellow and green wires. The resistance should be $350\Omega \pm 10$.
4. With the Voltmeter set to Ohms, measure the resistance between pins. Each of the open wires red, blue, green, yellow and the case of the transducer. There should be no connection between the case and any of the pins.



Rod Pressure Transducer

1. With the power to the computer off, disconnect the piston pressure transducer from the terminal block +DR, -DR, TXO+ and TXO- within the computer.
2. With the Voltmeter set to Ohms, measure the resistance between the yellow and green wires. The resistance should be $350\Omega \pm 10$.
3. With the Voltmeter set to Ohms, measure the resistance between pins, each of the open wires and the case of the transducer. There should be no connection between the case and any of the pins.

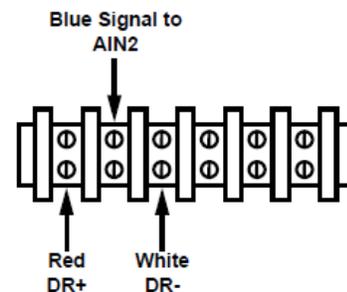
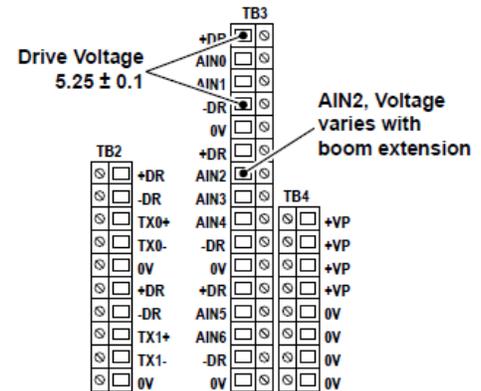
Pressure Channel Fault Guide

Unlike the MG3a series, the MG4 series does not have a dual channel pre-amplifier. Analog voltages relative to pressure cannot be measured in the computer.

AIN0 and AIN1 have difference functions in the MG4 system and are not to be used to monitor pressure voltages.

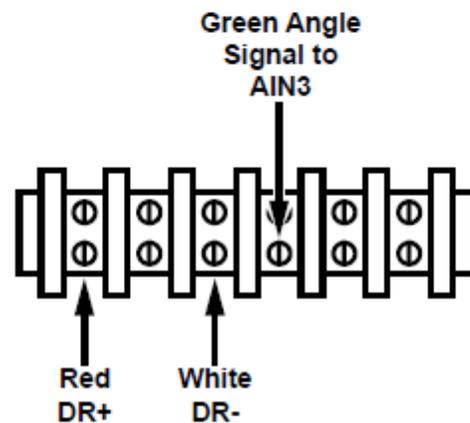
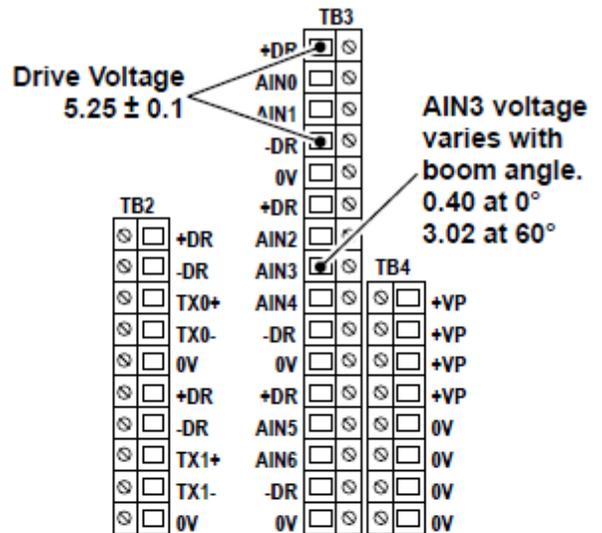
Check Boom Extension Sensor Voltage AIN2

1. Fully retract the boom.
2. Access the computer and termination boards. Measure the analog sensor drive voltage.
3. With the Voltmeter set to read DC voltage, place the negative lead on any 0 Volt terminal of the analog input group.
4. Place the positive lead of the meter on the AIN2 terminal of the analog input group. The voltage should be greater than 0.25 volts.
5. Extend the boom as far as is safe. The boom does not need to be horizontal for this test.
6. The voltage should be less than 5 volts. Usually around 2.5 volts depending on the boom length.
7. During extension, the voltage should increase linearly. During retraction, the voltage should decrease linearly.
8. If the voltage is out of the range listed above, remove the four screws that secure the cover on the extension reel and remove the cover.
9. Under the cover on the right side of the extension reel is a terminal strip. This terminal strip has six wires connected to the bottom screws.
10. With a digital voltmeter set to read DC voltage, place the negative lead on the terminal with the attached white wire (-Drive) and the positive lead on the terminal with the attached red wire (+Drive).
11. The voltage should be 5.25 ± 0.1 volts. If this voltage is out of range, and if the analog drive voltage measure in the computer was OK, it is possible the cable is open or grounded between the computer and the extension reel. Check all connections and plugs between these two components. Repair or replace as required.
12. With the negative lead of the voltmeter connected to the white drive (DR-) and the positive lead of the voltmeter connected to the blue AIN2 extension signal, the voltage should be the same as the voltage measured at AIN2 of the analog input group in the computer. If this voltage is not the same, it is possible the cable between the reel and computer is faulty. The blue and white wires at the reel reverse at the connector of the reel. The white -DR at the reel is blue -DR in the computer. The blue signal extension AIN2 at the reel is white AIN2 in the computer.



Boom Angle Sensor AIN3

1. Place the main boom at 0° angle. Verify with a digital level.
2. Access the Termination Board. Check the Analog Drive Voltage page 32.
3. With a digital voltmeter set for DC volts, connect the negative lead of the meter to any 0 (zero) volt terminal of the Analog Input Group.
4. Connect the positive lead to the AIN3 terminal of the Analog Input Group.
5. With the boom horizontal, the voltage should be 0.4 ± 0.1 volts.
6. Raise the main boom to a 60° angle. Verify with a digital level.
7. With the boom at 60°, the voltage should be 3.02 ± 0.1 volts.
8. If out of this range, remove the cover from the extension reel.
9. Under the cover on the right side of the extension reel is a terminal strip. This terminal strip has six wires connected to the bottom screws.
10. With the voltmeter set to read DC voltage, place the negative lead on the terminal with the white wire (-Drive) and the positive lead on the terminal with the red wire (+Drive).
11. The voltage should be 5.25 ± 0.1 volts. If this is out of range and the Analog Drive Voltage is OK, it is possible the extension reel cable is open or grounded between the computer and the extension reel. Check all connections and plugs between these two components. Repair or replace as required.
12. If the negative lead of the voltmeter is connected to the white drive (negative) and the positive lead of the voltmeter is connected to green (angle signal), the voltage should be the same as the voltage measured at AIN3 of the analog input group in the computer. If this voltage is not the same, the cable between the extension reel and the computer is faulty or the boom angle sensor is faulty.
13. If the above voltage checks are within range and no grounds or opens are found in the wires, replace the Boom Angle Sensor.

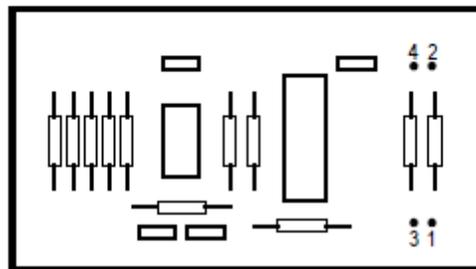
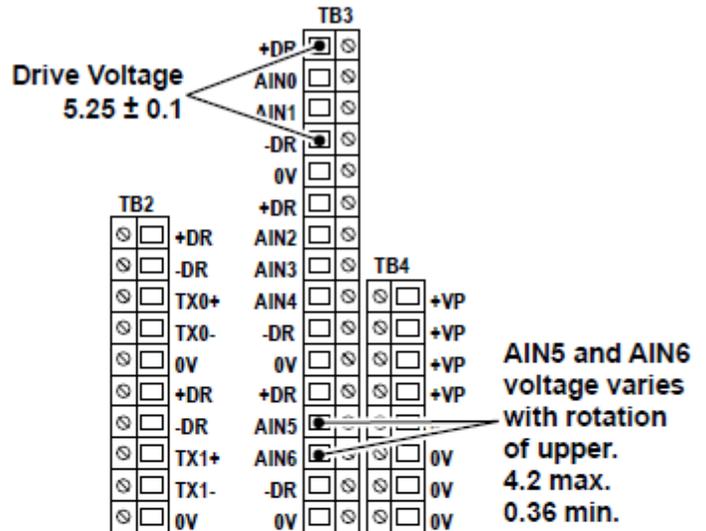


Swing Potentiometer

AIN5 and AIN6

Determine the position of the upper structure in relation to the carrier. This is done with a swing potentiometer mounted in the collector ring. If the system does not have input from the swing potentiometer, it will not be able to find a duty. Use the following procedure to check the Swing Potentiometer.

1. Access the termination board. Check the Analog Drive Voltage.
2. With the voltmeter set to DC volts, check the voltage at the connections to the potentiometer located on the Anti Two-Block board. Connection 1 has a red wire attached to it and connection 3 has a black wire attached to it.
3. Connect the black lead of the voltmeter to connection 3 (black wire) and the red lead of the voltmeter to connection 1 (red wire). The voltage should be 4.125 ± 0.1 volts. If this voltage is out of range, the termination board may need to be replaced.
4. With the black lead on any 0 volt terminal, check the voltage at the AIN5 terminal and AIN6 terminal. The voltage should be 4.50 ± 0.1 maximum and 0.365 ± 0.1 minimum. Both of these should rise and fall linearly within this range as the upper is rotated left or right. If the Drive Voltage and the Voltage at the connection to the potentiometer were correct and the voltages on AIN5 and AIN6 are out of range, the swing potentiometer will need to be replaced. Contact your distributor or your Factory Service Department for procedures on replace the swing potentiometer.



Voltage measured between 2 and 4 = 5.25 volts.
Voltage measured between 1 and 3 = 4.125 volts.

No Duty Found

The System requires the same information the operator needs in order to read a load chart. If for any reason this information is not available, the fault "No Duty Found" will display. This fault could occur if either the Boom Angle Sensor or the Extension Sensor inputs are faulty. The System uses these inputs to determine the duty selection. The System also uses information from the swing potentiometer to permit duty selection. Correcting the system fault will allow the system to find a duty.

Other System Faults

Executive ROM

The Executive ROM fault code indicates failure of IC2 on the main processor board. This chip can be replaced without the need for calibration. The chip is labeled M454400X.

Personality ROM

The Personality ROM fault code will be present until the system is fully calibrated. At the completion of calibration, a code is automatically inserted into the memory, which enables the system to carry out the self-test. If the fault code occurs in normal service, it could indicate either a failure of IC7 or the loss of data in the device. It will be necessary to obtain a copy of the Personality ROM that was made at the completion of the initial calibration or carry out a complete recalibration of the system. Contact your Distributor or Factory Service Department for details.

Scratchpad RAM

The Scratchpad RAM fault code indicates the failure of IC6 on the Processor Board. This item is not user serviceable and requires the replacement of the Processor Board.

Duty ROM

This fault indicates failure of the Duty Chip IC3 on the Processor Board. It can be replaced without the need for recalibration. It contains the load chart data for the crane on which it is fitted and must be identical to the load chart on the crane.

Current Duty Bad

This fault indicates failure of the Duty Chip IC3 on the Processor Board. It can be replaced without the need for recalibration. It contains the load chart data for the crane on which it is fitted and must be identical to the load chart on the crane.

Configuration Uncalibrated

When a crane is initially calibrated, its duty chip may contain more configurations than are to be sold with that particular crane. Fly or Jib options that are not supplied with the crane will not show up in the Crane Setup menu. Refer to the Calibration Procedure, Command 13 to hide or show attachments.

Digital I/O & Analog I/O

Digital and Analog I/O faults are not user serviceable. When this fault code is detected, it will be necessary to replace the processor board.

Display Unit

This unit is not user serviceable. When this fault code is detected, it will be necessary to replace the Display Unit.

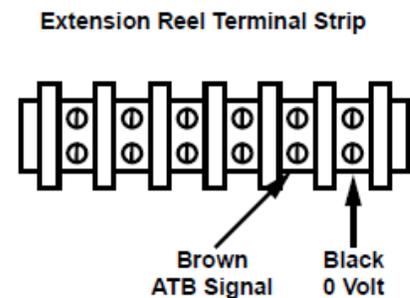
Anti Two-Block System

System will not show Two-Block when the Crane is Two-Blocked

1. Access the Termination Board.
2. Remove and separate the violet and brown wires connected to the ATBIN terminal of the digital input group. The system should now show an Anti Two-Block warning.
 - If the Anti Two-Block warning does not occur with the wires removed from the terminal strip, the problem is in the termination board.
 - If the Anti Two-Block warning occurs with the wires removed from the terminal strip, the problem is outside of the computer and is in the ATB switches and/or cables. Reconnect the wires to the ATBIN terminal.
3. Remove the four cover screws from the extension reel and remove the cover.
4. Remove the brown wire from the terminal strip. The system should now show an Anti Two-Block warning. If it does not, the brown wire of its connections between the Terminal Board and the extension reel are shorted to ground. If it does, there is a short circuit to ground in the wiring or connections between the extension reel and the switch at the boom head.
5. Check all wires and connections between the computer and the reel and switches and repair or replace as required.

System shows Two-Block when crane is not Two-Blocked

1. Ensure the selection switch of the Two-Block switch located at the main boom head is correctly set.
2. Ensure the Anti Two-Block weight is attached to the boom head switch.
3. Access the Termination Board.
4. Connect a jumper wire from the 0volt terminal to the ATBIN terminal leaving the brown and violet wires in place in the ATBIN terminal. The Anti Two-Block warning should no longer be displayed.
 - In the Anti Two-Block warning remains, the problem is in the termination board assembly.
 - If the Anti Two-Block warning goes away with 0volt connected to ATBIN, the problem is in the external wiring or switches.
5. Remove the jumper wire connected in Step 4. Remove the four screws from the extension reel.
6. Connect a jumper wire between the black wire and the brown wire on the terminal strip. The Anti Two-Block warning should no longer be displayed. If it remains, the brown wire is open between the Termination board and the Extension Reel.



If the warning is no longer displayed, the problem is somewhere between the extension reel and the boom head switch. Check all wires and connections between these components and repair or replace as required.

Anti Two-Block Logic Levels

The signal from the Anti Two-Block switches at the boom and fly tips is a switched ground. The ground signal is powered in the computer at the 0 volt terminal of the digital input group.

When there is no ATB alarm, the switches at the boom head are closed allowing the ground to be returned to the computer at the ATBIN terminal.

When there is a Two-Block condition, the appropriate ATB switch will go to the open position, removing the ground from the ATBIN and cause the ATB alarm and function kick-out.

The ATB alarm and function kick-out are controlled separately by the ATB board in the computer.

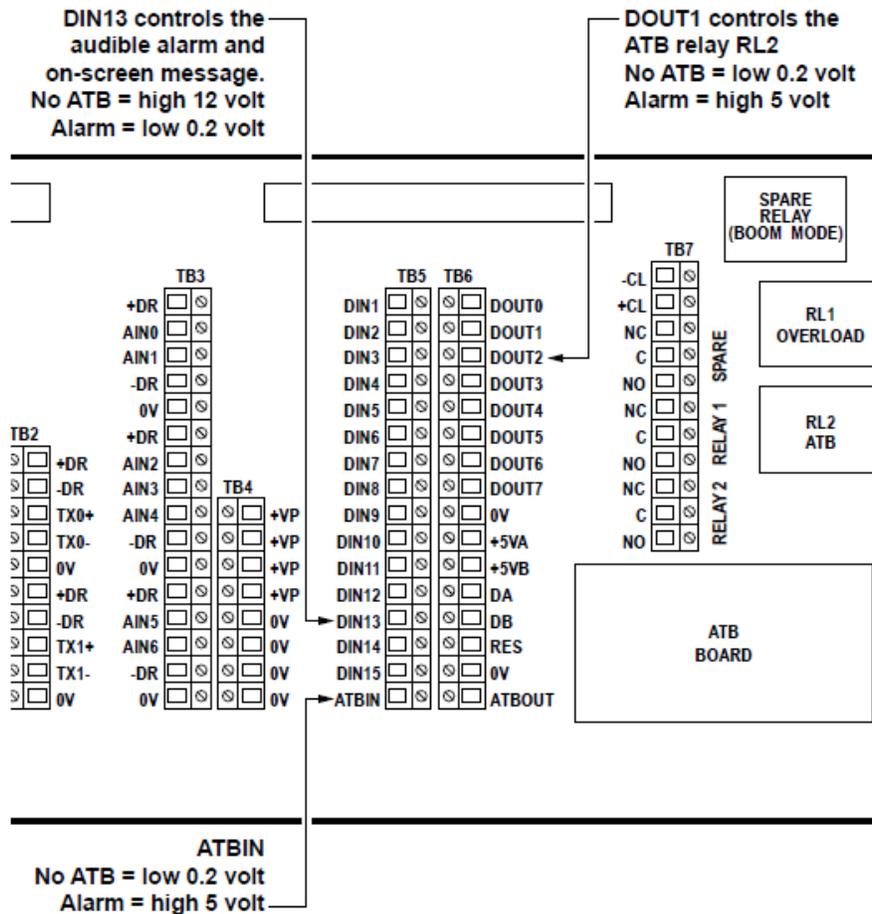
The ATB board, located in the computer box:

- Operates the function kick-out by controlling the coil RL2, ATB relay at D OUT 1.
- Operates the audible alarm and on screen message by controlling the logic level at DIN13.

The logic levels:

	NO ALARM	ATB ALARM
ATB SWITCH	CLOSED	OPEN
ATBIN	LOW 0.2 VOLT	HIGH 5 VOLT
D OUT 1	LOW 0.2 VOLT	HIGH 5 VOLT
D IN 13	HIGH 12 VOLT	LOW 0.2 VOLT

The voltage levels are approximations and small variations are to be expected.



Pressure Transducer Replacement

1. It is recommended the replacement transducer is closely matched to the sensitivity of the old transducer. The sensitivity value is recorded on the serial number plate.
2. Remove the connector attached to the transducer to be replaced.
3. With the boom cylinder completely retracted, or with the boom safely supported, remove the transducer.
4. Install the new transducer on the boom hoist cylinder.
5. Run the cable to the computer box and connect it to the appropriated connector.
6. Pick a known weight to verify the system. If the load reading is not within tolerance, go Menu 03 Zero for the appropriate sensor only. Check accuracy again. If the system is still out of tolerance, go to Menu 06 Pressure and Menu 07 Radius Moment. This should correct the inaccuracies.

Extension Reel Replacement

If using the rectangular-type extension reel, replace the extension reel assembly using the following procedure. If using the newer style round extension reel, replace the extension reel assembly following the appropriate manual for your extension reel.

1. Fully retract the main boom.
2. Disconnect the connector to the ATB switch and remove the cable from the main boom head anchor. Allow the cable to retract onto the reel. Do not let the cable retract too quickly.
3. Remove the extension reel cable connector.
4. Remove the four mounting bolts securing the extension reel to the boom. Remove the reel.
5. Mount the new reel to the boom, secure with mounting bolts and connect the extension reel cable connector.
6. Remove the shipping cable clamp from the new cable and allow it to slowly rewind onto the reel until there is no pre-tension. Continue to rewind the reel in the same direction until the distance between the boom head and the connector is approximately 12ft. At this point there will be no pre-tension.
7. Pull the cable out, passing it through the cable guides until the end of the cable is 3ft beyond the boom head.
8. Wrap the cable around the boom head anchor a minimum of five times and secure with a wire tie or shipping cable clamp.
9. Connect the cable to the connector coming from the ATB switch.
10. Manually turn the large gear connected to the potentiometer fully counterclockwise.
11. Observe the length display and turn the large gear at least three clicks clockwise until the length display reads the retracted boom length.
12. Replace the extension reel cover with the four screws.
13. Extend and retract the main boom and ensure the boom length reading on the display is correct.

Boom Angle Sensor Replacement

1. With the power off, remove the four bolts holding the extension reel cover and remove the cover.
2. Disconnect the three wires connecting the angle sensor to the terminal strip. Remove the two bolts securing the sensor to the extension reel and remove the old angle sensor.
3. Install the new sensor in the extension reel in the original location, secure it with the mounting bolts and connect the cable.
4. Raise the boom to 60° and verify the angle with a digital level. While viewing the display, adjust the sensor until the display reads 60°. Tighten the mounting bolts.
5. Lower the boom to 0° and verify the angle with a digital level.
6. Verify the displayed boom angle reads $0^\circ \pm 0.5^\circ$

Processor Board Replacement

1. With the power off, access the Processor Board.
2. Locate the two ribbon cables connecting the Processor Board to the Termination Board.
3. The ribbon cables are held in place by two locking tabs on each cable end. Push the locking tabs away from the cable to disconnect the cable. As the locking tabs are pushed, the connector will loosen from the Processor Board.
4. Loosen the two screws holding the computer backing plate to the box.
5. Remove the Processor Board Assembly.

There are three computer chips on the processor board that must be correct:

- IC2 Executive ROM
- IC3 Duty ROM
- IC7 Personality ROM

The Executive ROM must be specific to the System.

The Duty ROM contains a copy of the load chart and must correspond to the Load Chart Number of the particular serial number of the crane.

The Personality ROM contains data that is unique to the particular serial number of the crane.

1. Install the Executive ROM chip, the Duty ROM chip, and the Personality ROM chip.
2. Place the Computer Assembly into the computer box and tighten the two mounting screws, leave room to access the ribbon cables.
3. Reconnect the two ribbon cables. Fully engage the connector and locking tabs.
4. Replace the Computer Box cover and secure with the four screws.

Computer Box Replacement

Terminal Board and Box Only

Use the Processor Board from the original box.

1. Remove the processor board.
2. Label each cable, then label each wire with its terminal location. Remove the cable from the gland entry. Repeat with each cable.
3. Remove the four screws securing the computer box.
4. Remove the computer box.
5. Install the new computer and secure with the four mounting screws.
6. Reconnect all cables in reverse of removal.

Chip Removal and Installation

For instructions on replacing program chips, please refer to the included Changeout document.

Outrigger Position Sensors

There is no troubleshooting available for the outrigger sensors. If an error code is displayed for a particular outrigger sensor, contact service for assistance. No calibration is needed.



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