



## RCI 410/400 System



TROUBLESHOOTING MANUAL



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## System Description

The MicroGuard RCI 510/400 system [hereinafter referred to as the "system"] is intended to aid the crane operator in the efficient operation of the crane by continuously monitoring the load and by warning of an approach to an overload or two-block condition.

The system, which functions with the RCI 510 Display and the MicroGuard 400 Series Computer, monitors crane functions by means of high accuracy sensors that continuously compare the load suspended below the boom head with data from the crane capacity chart stored in the memory of the computer. If an overload is approached, the system warns the operator by means of audible and visual alarms. The system can also be configured to cause function kick-out.

The Display provides the operator with a continuous readout of:

- Rated Capacity
- Actual Load
- Percentage of Rated Capacity
- Radius of the Load
- Angle of the Main Boom
- Working Area
- Crane Configuration
- Length of the Main Boom

On-screen messages provide the operator with visual indications of the various alarms that may occur during normal operation of the system. These values appear on the left display. The right display gives information about the currently selected crane configuration.

## Fault Diagnostic Procedures

Faults in the system are detected at start-up with an automatic self-test that lasts about 2-3 seconds. This self-test is activated each time the system is switched on. 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 appear in the information area.
- The RED LAMP 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 and 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 press the **TEST** button.

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

## Fault Codes

### Group “A” – Analog Sensors

#### CODE

AAA		
000	NO FAULTS	
001	AIN0	PISTON PRESSURE TRANSDUCER
002	AIN1	ROD PRESSURE TRANSDUCER
004	AIN2	EXTENSION SENSOR
008	AIN3	BOOM ANGLE SENSOR
016	AIN4	NOT USED
032	AIN5	SWING POTENTIOMETER “A”
064	AIN6	SWING POTENTIOMETER “B”

**NOTE** Code 003 (001+002) indicates a fault in both the piston and rod pressure transducer.

### Group “B” – Inputs And Outputs

#### CODE

B		
0	NO FAULTS	
1	1	DIGITAL INPUT AND OUTPUT
2	2	ANALOG INPUT AND OUTPUT
4	4	DISPLAY UNIT

**Group "C" – Memory**

CODE

CC

00	NO FAULTS
01	1 EXECUTIVE ROM
02	2 DUTY ROM
04	4 SCRATCHPAD RAM
08	8 PERSONALITY ROM

**Group "D" – General**

CODE

DD

00	NO FAULTS
01	1 NO DUTY FOUND
02	2 CURRENT DUTY BAD
04	4 CONFIGURATION UNCALIBRATED

**NOTE**

Code 03 (01+02) indicates a fault in the duty program and requires replacement.

**Group 'A' Fault Codes**

When a fault is detected by the system, a number will appear under one or more of the four group headings A through D, shown on the previous page. This number will correspond to one or more fault diagnostic numbers. The meaning of these numbers can be determined by looking at the appropriate code in the fault interpretation table.

**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 six seconds that automatically detects most faults in the system. During normal operation, a self-test can be initiated at any time by pressing the **TEST** button on the display console.

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.
- "WARNING SYSTEM FAULT!" will be displayed at the bottom of the text window.

Fault codes may be displayed on the display console. To view the codes, press and hold the Test button and wait for the system to complete the self-test. Do not release the TEST button. Fault codes will now be displayed at the bottom of the text window for as long as the TEST button is held down.

There are four groups of Fault Codes: A, B, C, and D. The function of these groups and a complete listing of each code is provided on the following pages.

Always investigate faults in the "B" and "C" groups before continuing with "A" and finally "D" group faults.

**Examples Of Fault Codes:**

Fault 0

AAA B CC DD

000 0 00 00

No faults detected.

Fault 7

AAA B CC DD

007 0 00 00

Piston pressure transducer

Rod pressure transducer

Fault 1

AAA B CC DD

001 0 00 00

Piston pressure transducer.

Extension sensor

Fault 8

AAA B CC DD

008 0 00 00

Fault 2

AAA B CC DD

002 0 00 00

Rod pressure transducer

Boom angle sensor

Fault 9

AAA B CC DD

009 0 00 00

Fault 3

AAA B CC DD

003 0 00 00

Piston pressure transducer

Rod pressure transducer

Piston pressure transducer

Boom angle sensor

Fault 10

AAA B CC DD

010 0 00 00

Boom angle sensor

Rod pressure transducer

Fault 4

AAA B CC DD

004 0 00 00

Extension Sensor

Fault 11

AAA B CC DD

011 0 00 00

Boom angle sensor

Fault 5

AAA B CC DD

005 0 00 00

Piston pressure transducer

Extension sensor

Piston pressure transducer

Rod pressure transducer

Fault 32

AAA B CC DD

032 0 00 00

Fault 6

AAA B CC DD

006 0 00 00

Rod pressure transducer

Extension sensor

Rod pressure transducer

Swing potentiometer "A"

Fault 64

AAA B CC DD

064 0 00 00

Swing potentiometer "B"

### Fault 96

AAA	B	CC	DD
096	0	00	00
Swing potentiometer "A"			
Swing potentiometer "B"			

This sequence continues up to the maximum fault code of 127, which is the sum of all "GROUP A" fault codes.

### Fault 127

AAA	B	CC	DD
127	0	00	00

All analog sensors.

This fault condition is seldom caused by the simultaneous failure of all sensors. It is usually the result of the failure of the analog drive voltage, which supplies the voltage for all sensors. This power supply fault may be due to the failure of the power supply or may be due to damage to the cable that connects the sensor to the computer.

When this fault occurs, carry out Power Supply Voltage checks before checking individual sensors.

## Voltage Checks

### Power Supply Voltages

The computer unit contains two major boards: the processor board and the termination board. Both of these assemblies are located in an aluminum box that is usually located on the rear wall of the cab and can be inside or outside the cab depending on crane model. All of the cables from the various sensors and the display are connected to the termination board. To access the termination board, refer to "The Processor Board" and "The Termination Board" on page 29.

### Input Power

The computer operates from an input voltage in a range from 9 to 36 volts DC. This input voltage is measured across the B+ and B- terminals on the Termination Board and corresponds to the battery voltage of the crane. At voltages below 9 and above 36 volts, the system will power down until correct voltage is restored.

If the input power is not within these limits, check the battery and/or alternator before servicing the computer.

### Internal Power Supplies

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

This power can be monitored at the test points inside the computer adjacent to the fuses and battery input terminals.

Terminal	Voltage
B+	+10V to +26V
+VP	+12V ± -0.5V
+5	+5V ± 0.1V
+15	+15V ± 0.1V
-15	-15V ± 0.1V

To monitor the internal power supplies, use a digital voltmeter set to the appropriate VDC setting and attach to the appropriate voltage check points on the terminal board. Note the two power supplies sitting side-by-side on the board. The larger (left) power supply provides 5 V power. The smaller (right) power supply provides 15 V. There are two fuses on the face of the board immediately above the voltage checkpoints. These 1A fuses, labeled "FS1" and "FS2," protect the functions of display power and power supply. Replace these fuses **ONLY** with an identical replacement, or damage may occur to the main board or tracings.

Connect the black (-ve) lead to GND.

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.

Before replacing the computer, contact the Support Department.

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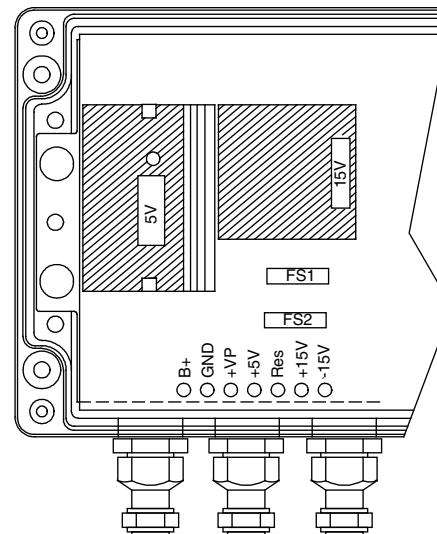


Figure 1 - Internal Power Terminals

## The Processor Board And The Termination Board

### **⚠ WARNING**

THE COMPUTER IS AN ESD SENSITIVE DEVICE. YOU MUST MAINTAIN A STATIC SAFE WORK ENVIRONMENT. USE A FIELD SERVICE GROUNDING KIT OR OTHER STATIC DISSIPATIVE PRODUCT WHILE HANDLING THE COMPUTER AND/OR COMPONENTS.

1. Remove the four screws (B) that secure the lid [A] to the computer box [G]. Remove the lid and set it aside. The lid is **NOT** hinged. Be careful not to allow the lid to slide off the box.
2. Below the lid is the Processor Board (E). This board contains the microprocessor and its related components. This unit is held in place by two screws (D) located at the left and right of the Processor Board mounting plate (C). The Processor Board is connected to the Termination Board (H) via two ribbon cables (K), positioned side by side, 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) controls 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.

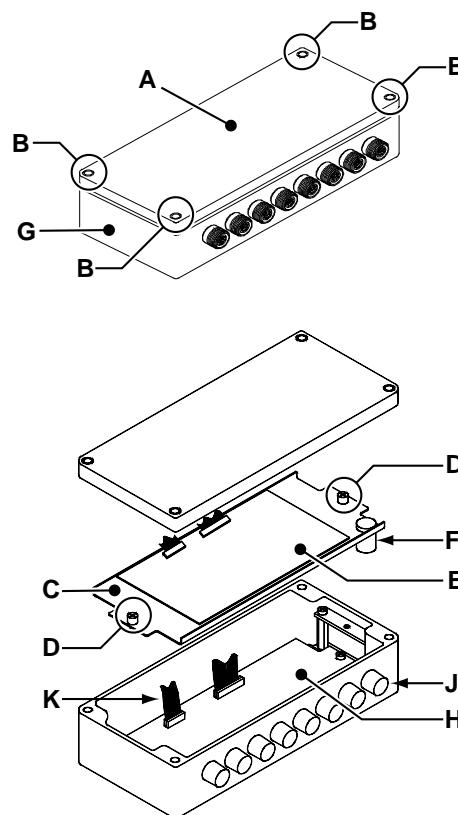


Figure 2 - Computer Box (exploded view)

## Terminal Block

Terminal blocks are marked as shown in the illustration. There are multiple drive voltage terminals (DR+ and DR-) in different locations. These terminals are all common on the computer board assembly. The same is true of any OV or +VP terminals. For example, checking the drive voltage on TB2 should provide exactly the same readout as at any drive voltage terminals on TB3.

AIN2 and AIN3 are typical voltages checkpoints for analog input signals from the boom angle and length pots. These signals will vary depending on how the unit is operated at the time the reading is taken. Refer to the maintenance manual for further definition of terminal blocks.

Because the drive voltages are all common, any analog sensor can be suspect. If, for example, drive voltage is low, and +15 V is within tolerance, each of the analog sensors must be removed, one at a time, until the sensor that is causing the voltage to sag is located and replaced. If the voltage continues to sag, the processor board should be replaced as the drive voltage power supply is integrated into the processor board.

This is a simple process of elimination, which will help pinpoint a failing sensor, an abrasion, or a pinch in a wire or loom. All wiring could become suspect at this time and should be carefully checked. Output tests can also be run at the sensors by attaching the voltage meter at the sensor output and watching as the sensor is extended or raised. Voltage skips or gaps can be detected using this technique.

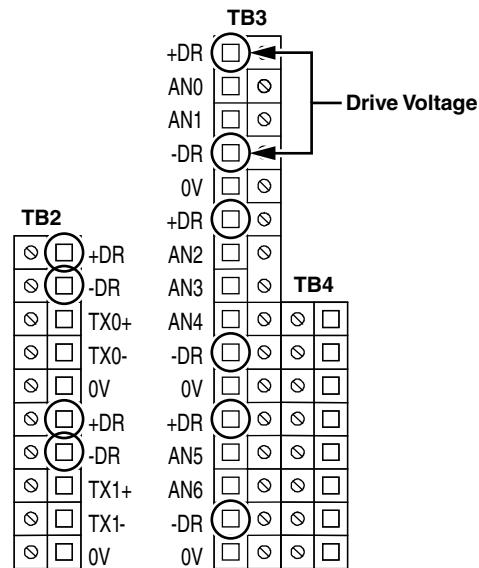


Figure 3 - Drive Voltage Check

## Checking Analog Drive Voltage

To check the analog sensor drive voltage, use the following procedure:

1. Access the termination board.
2. With the system power on and a digital volt meter set to read DC voltage, place the negative lead on **any** -DR (- Drive) terminal [1] of the analog input group.
3. Place the positive lead of the meter on **any** +DR (+ Drive) terminal [2].
4. The voltage should be  $5.25 \pm 0.1$ volts.
5. If the analog drive voltage is not within this range, disconnect all of the external sensor cables, including pressure transducers, cables 1 through 5.
6. 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.
7. If the analog drive voltage goes out of range after reconnecting any one of the sensors, it is probable that 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.

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

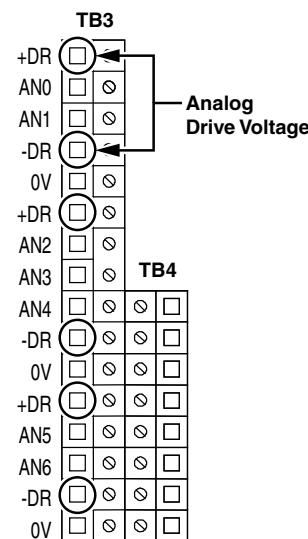


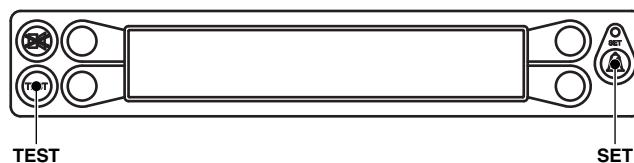
Figure 4 - Checking the Analog Drive Voltage

# Pressure Channel Fault Guide Functional Tests

## Pressure Transducers

A fault in a pressure transducer is such that a fault on 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 transducer is at fault.

1. Access the calibration routine. Hold down the **TEST** and **SET** keys simultaneously. The audible alarm will sound and you will be prompted to enter the security key code.



2. Enter the security code in order (1, 2, 3, 4) as shown.



If the wrong sequence is used or if the entry is not completed within 5 seconds, the calibration entry will be aborted and must be re-entered. After accessing the calibration routine, the system alarm will sound indicating that the system is in the calibration routine.

3. Press the key adjacent to either "Menu Up" or "Menu Down" until "03 Zero Sensor" appears in the information window at the right.
4. Press the key adjacent to "03 Zero Sensor" to enter the routine.
5. Press the key adjacent to either "Menu Up" or Menu Down" to go to "TX0" [pressure transducer 0 piston side]. View sensor and bits.
6. With the boom in the rest or the boom hoist cylinder fully retracted, relieve all pressure from both transducers. With no pressure, the upper display should indicate  $0 \pm 20$  bits.
7. Press the key adjacent to either "Menu Up" or Menu Down" to go to TX1 [pressure transducer 1 rod side]. With no pressure in the cylinder, the upper display should read  $0 \pm 20$  bits.
8. If the transducers were disconnected in step 5, tighten the fittings. With the boom fully retracted, boom up to a  $60^\circ$  angle.
9. Access the Zero of TX0, as described in step 5; the upper display should read  $200 \pm 100$  bits.
10. Access the Zero of TX1, as described in step 7; the upper display should read  $5 \pm 25$  bits.
11. Boom down. As the boom is moving down, the displayed bits of TX1 should increase.
12. Place the retracted boom at a  $60^\circ$  angle. Access the Zero of TX0, as described in step 4, and extend the boom. As the boom is extended, the displayed bits of TX0 should increase. When the boom is fully extended, the display should read  $400 \pm 100$  bits for a three-section boom and  $600 \pm 100$  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 TX0 under the same conditions 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. Refer to the Section in this manual for pressure transducer replacement.

13. When you are finished, press the key adjacent to "Exit".

If the foregoing functional tests indicate 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. The following resistance tests can be carried out to establish the viability of the pressure transducer.

### Piston Pressure Transducer

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

1. With the power to the computer off, disconnect the piston pressure transducer from the terminal blocks +DR, -DR, TX0+ and TX0- within the computer.

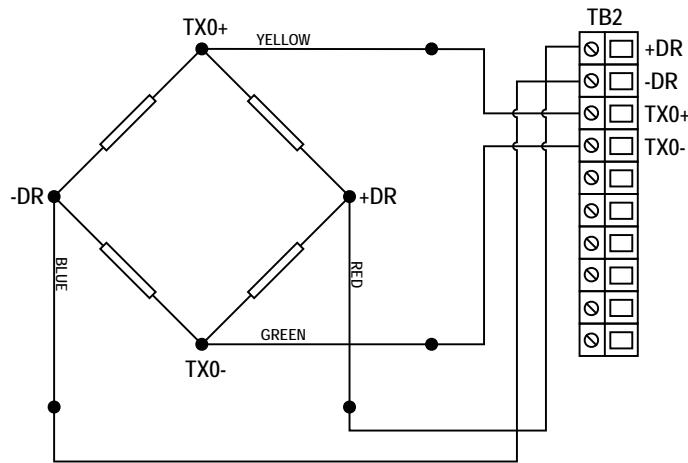


Figure 5 - Pressure Transducer Connections

2. Using a digital volt meter set to the Ohms ( $\Omega$ ) range, measure the resistance between red and blue wires. The resistance should be  $350\Omega \pm 10\Omega$
3. Next, measure the resistance between yellow and green wires. The resistance should be  $350\Omega \pm 10\Omega$ .

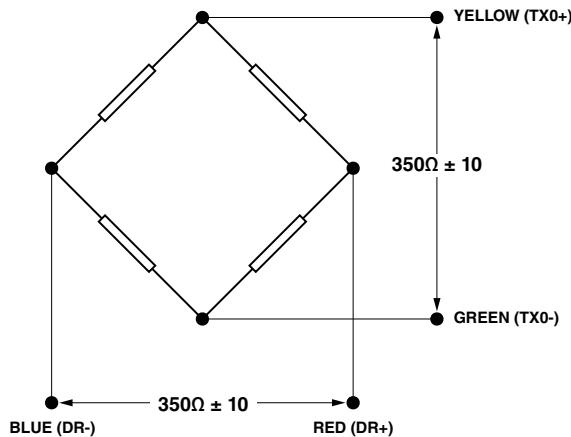


Figure 6 - Pressure Transducer Voltage

4. Next, measure the resistance between 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

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

1. With the power to the computer off, disconnect the piston pressure transducer from the terminal blocks +DR, -DR, TX1+ and TX1- within the computer.

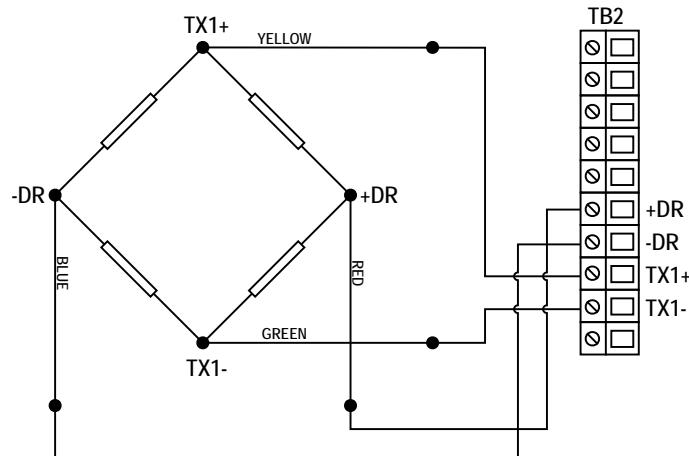


Figure 7 - Pressure Transducer Connections

2. Using a digital volt meter set to the Ohms ( $\Omega$ ) range, measure the resistance between red and blue wires. The resistance should be  $350\Omega \pm 10\Omega$
3. Next, measure the resistance between yellow and green wires. The resistance should be  $350\Omega \pm 10\Omega$ .

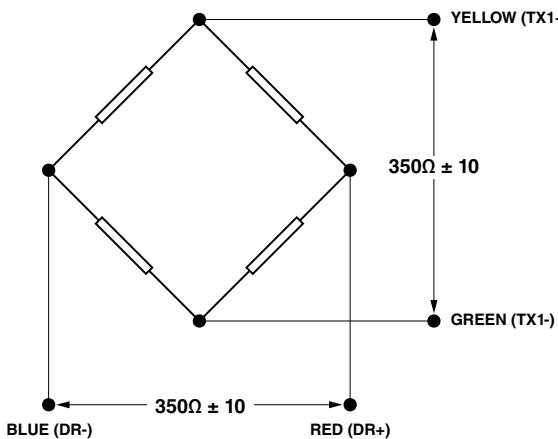


Figure 8 - Pressure Transducer Voltage

4. Next, measure the resistance between 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.

### Pressure Channel Fault Guide

#### Analog Drive Voltage

Analog sensor voltages are measured at the analog input group terminals.

The drive voltage for all analog sensors is measured between any +DR and -DR in the analog input group and is 5.25 volts DC  $\pm$  0.1

To measure this voltage, use a digital voltmeter set to the DC voltage range.

1. Connect the black (negative) lead of the DVM to any DR- terminal in the analog input group.
2. Connect the red (positive) lead of the DVM to any DR+ terminal in the analog input group.
3. Measure the drive voltage. [volts DC  $\pm$  0.1]
4. If the voltage is out of range, disconnect all of the analog sensors by disconnecting the sensor connectors from the computer to determine if any sensor or its cabling is causing the drive voltage to be incorrect.
5. If the drive voltage is correct with all of the sensors disconnected, connect each sensor in turn to determine which sensor is causing the drive voltage to be incorrect.
6. If any sensor is causing the drive voltage to be incorrect, carry out the troubleshooting procedure for that sensor.

If the drive voltage is incorrect with all sensors disconnected, it may be necessary to replace the computer.

Before replacing the computer, carry out the Power Supply Tests beginning on page 6 of this manual.

#### For Technicians Familiar With MG3:

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 different functions in the MG4 system and are not to be used to monitor pressure voltages.

## Boom Extension Sensor AIN2

To check the Boom Extension Sensor Voltage, follow the procedure below.

1. Fully retract the boom.
2. Access the computer and termination boards.

**NOTE** Measure the analog sensor drive voltage. Refer to "Checking Analog Drive Voltage" on page 9.

3. With a digital 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 to do so. The boom need not 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, which is located on the left side of the main boom section; 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  $5.25 \pm 0.1$  volts. If this voltage is out of range, and if the analog drive voltage measured in the computer was okay, it is possible that the cable is open or grounded between the computer and the extension reel. Check all connections and plugs that may be 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 that the cable between the reel and the computer is faulty.

The blue and white wires at the reel reverse at the connector of the reel. Therefore, 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.

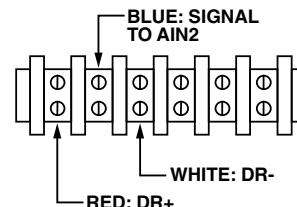


Figure 9 - Boom Extension Sensor Voltage

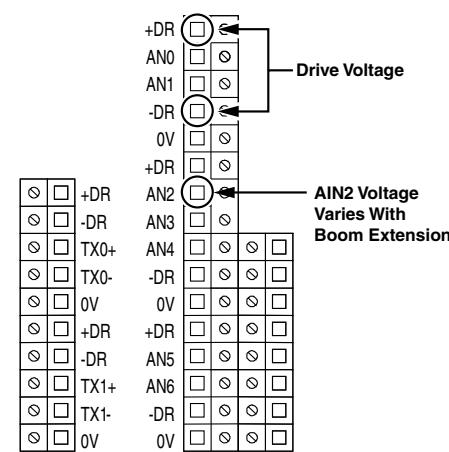


Figure 10 - Boom Extension Sensor Voltage

## Boom Angle Sensor AIN3

1. Place the main boom at a 0° angle. Verify that it is at a 0° angle with an inclinometer.

**NOTE** Measure the analog sensor drive voltage. Refer to "Checking Analog Drive Voltage" on page 9.

2. 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.
3. Connect the positive lead to the AIN3 terminal of the Analog Input Group.
4. With the boom horizontal, the voltage should be  $0.4 \pm 0.1$  volts.
5. Raise the main boom to a 60° angle. Verify that the main boom is at a 60° angle with an inclinometer.
6. With the boom at a 60° angle, the voltage should be  $3.02 \pm 0.1$  volts.
7. If this is out of range, remove the cover from the extension reel located on the left side of the main boom.
8. 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.
9. With a digital 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). The voltage should be  $5.25 \pm 0.1$  volts.
10. If this voltage is out of range and the Analog Drive Voltage checked is OK, it is possible that 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.
11. 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, it is possible that the cable between the extension reel and the computer is faulty or the boom angle sensor is faulty.
12. If the above voltage checks are within range and no grounds or opens are found in the wires, replace the Boom Angle Sensor, as described in this manual.

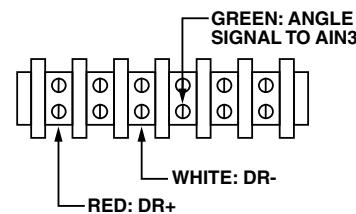


Figure 11 - Angle Sensor Voltage

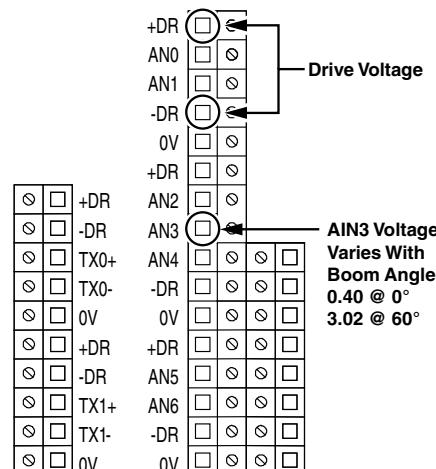


Figure 12 - Angle Sensor Voltage

## FKO Relays

There are two relays on the termination board (lower) that are marked Relay 1 and Relay 2. These relays are mounted in such a way, that they can work parallel with each other as well as separately. (When ATB function is tripped, the overload signal may still be closed (the opposite also applies))  
There are two signals that may interrupt the flow of power to the relay coils:

- The brown wire, which is the ground signal that is returning from the reel to the ATBIN port on the termination board
- The green signal that is directed by the processor on the upper board. If either connection to the relay coils is interrupted, it will cause function lockout.

This circuit is built into the circuit board, making it impossible to visually see the color-codes inside the computer. The purpose of this system is to be able to separate the two conditions when they occur, visually as well as with warnings on the display console.

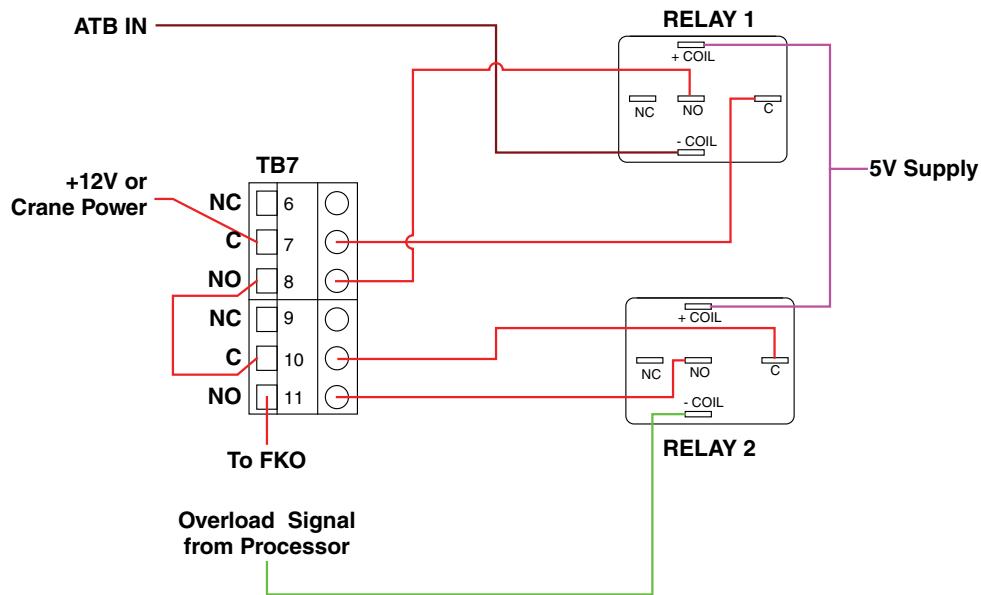


Figure 13 - FKO Schematic

## Swing Potentiometer

### AIN5 and AIN6

The position of the upper structure in relation to the carrier must be determined. This is accomplished by means of 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.

To check the Swing Potentiometer, follow the procedure below:

**NOTE** Measure the analog sensor drive voltage. Refer to "Checking Analog Drive Voltage" on page 9.

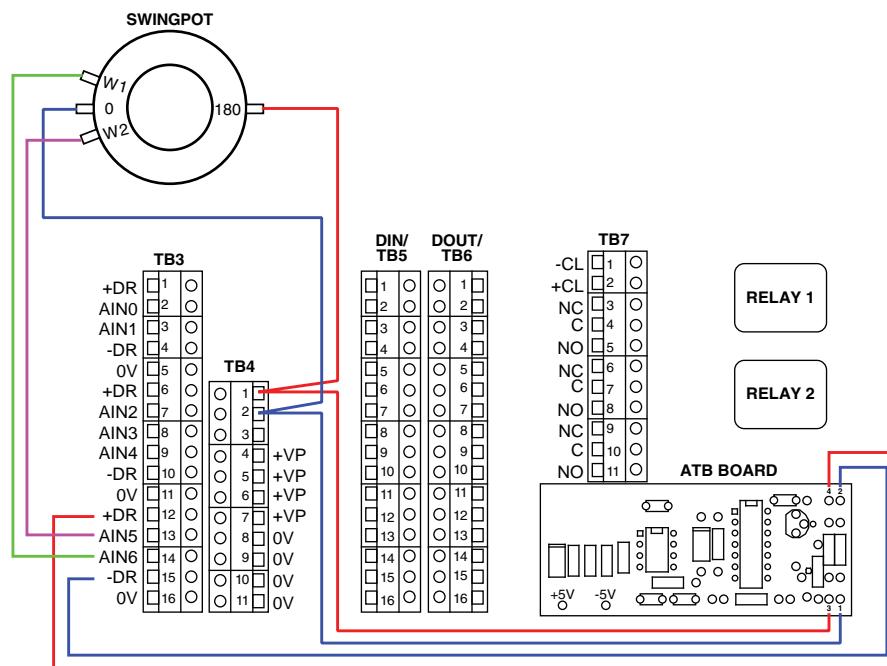


Figure 14 - Swing Pot Schematic

- With a digital voltmeter set for 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.
- Connect the black lead of the DVM to connection 3 (black wire) and the red lead of the DVM to connection 1 (red wire). The voltage should be  $4.125 \pm 0.1$  volts. If this voltage is out of range, the Termination Board may need to be replaced.
- With the black lead on any 0 Volt terminal, check the voltage at the AIN 5 terminal and AIN 6 terminal. The voltage should be  $4.50 \pm 0.1$  maximum and  $0.365 \pm 0.1$  minimum. Both of these voltages 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 replacing the swing potentiometer.

## Anti-Two-Block (ATB) System

### System Will Not Show Two-Block When The Crane Is Two-Blocked

#### **NOTE**

Measure the analog sensor drive voltage. Refer to "Checking Analog Drive Voltage" on page 9.

1. Remove and separate the violet and brown wires connected to the ATB IN terminal of the digital input group. The system should now show an anti-two-block warning.
  - A. If the ATB warning does not occur with the wires removed from the terminal strip, the problem is in the Termination Board.
  - B. If the ATB 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.
2. Remove the four cover screws from the extension reel located on the left side of the main boom and remove the cover.
3. Remove the brown wire from the terminal strip. The system should now show an ATB warning.  
If it does not, the brown wire or its connections between the terminal board and the extension reel are shorted to ground.  
If the system shows an ATB warning, there is a short circuit to ground in the wiring or connections between the extension reel and the switch at the boom head.
4. Check all wires and connections between the computer and the reel and switches and repair or replace, as required.

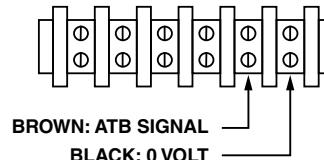


Figure 15 - ATB Voltage

### System Shows Two-Block When Crane Is Not Two-Blocked

1. Check that the selection switch of the ATB switch located at the main boom head is correctly set.
2. Ensure that the ATB weight is attached to the boom head switch.

#### **NOTE**

Measure the analog sensor drive voltage. Refer to "Checking Analog Drive Voltage" on page 9.

3. Connect a jumper wire from the 0 volt terminal to the ATBIN terminal leaving the brown and violet wires in place in the ATBIN terminal. The ATB warning should no longer be displayed.
  - A. If the ATB warning remains, the problem is in the termination board assembly.
  - B. If the ATB warning goes away with zero volts connected to ATBIN, the problem is in the external wiring or switches.
4. Remove the jumper wire connected in Step 3. Remove the four screws from the extension reel located on the left side of the main boom.
5. Connect a jumper wire between the black wire and the brown wire on the terminal strip. The ATB warning should no longer be displayed.
  - A. 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 ATB 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, thereby removing the ground from ATBIN and causing ATB Alarm and Function Disconnect.

The ATB alarm and Function Disconnects are controlled separately by the ATB board in the computer.

The ATB board, located in the computer box:

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

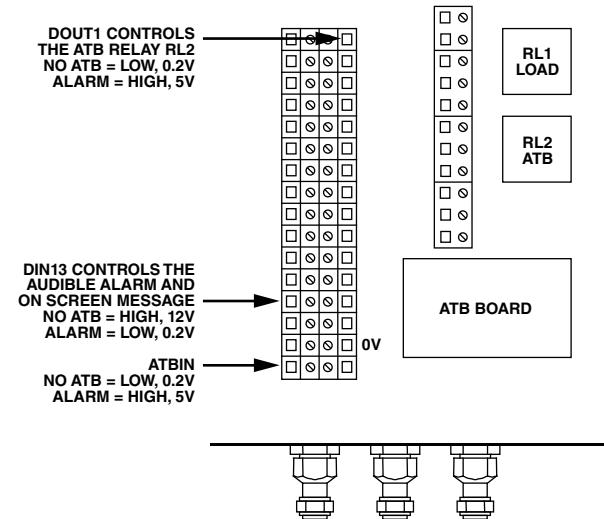


Figure 16 - ATB Voltage

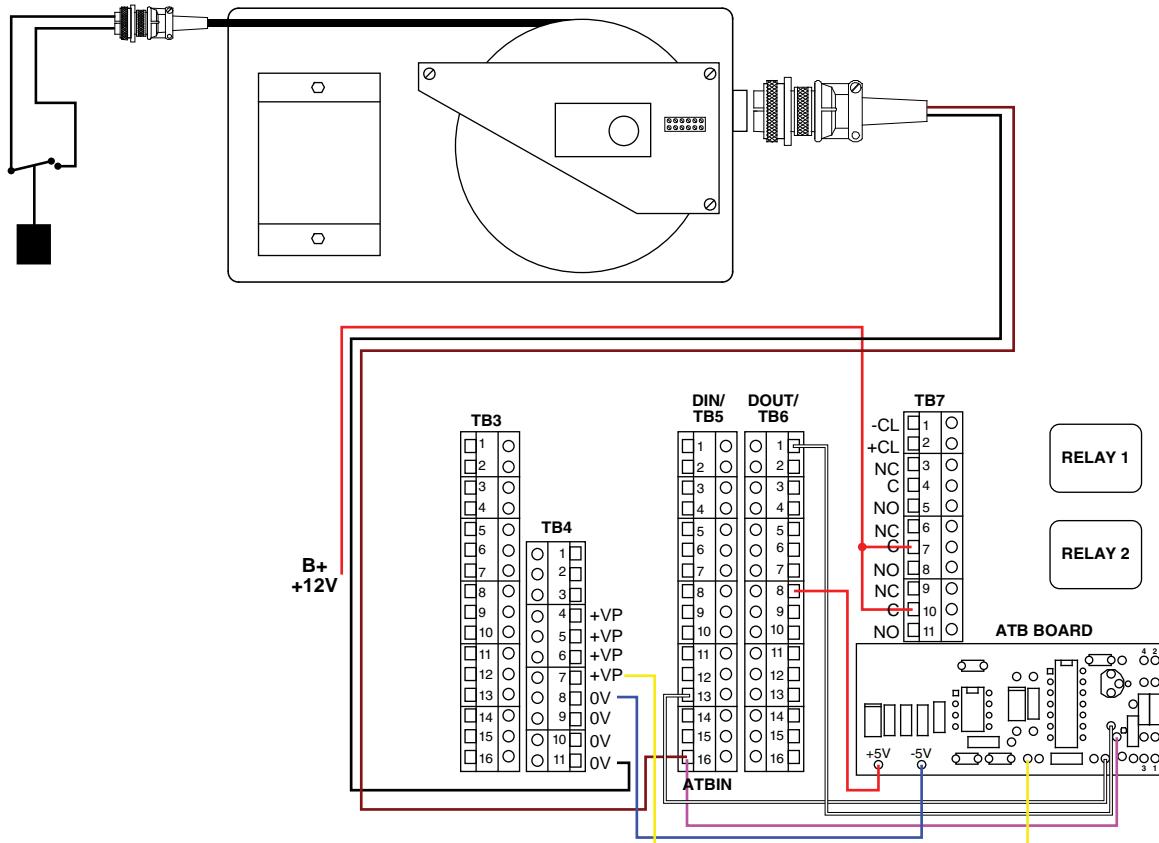


Figure 17 - ATB Schematic

The logic levels are as follows:

	<b>NO ALARM</b>	<b>ATB ALARM</b>
ATB SWITCH	CLOSED	OPEN
ATB IN	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.

# Component Replacement

## Pressure Transducer Replacement

1. It is recommended that 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 connecting the transducer to be replaced from the computer box.
3. With the boom cylinder completely retracted, in the rest, or with the boom safely supported, remove the transducer to be replaced.
4. Install the new transducer on the boom hoist cylinder.
5. Run the cable to the computer box and connect it to the appropriate computer box connector.
6. Pick a known weight to verify the accuracy of the system. If the load reading is not within tolerance after the replacement of a pressure transducer, first carry out Command 03 (zero sensors) for the appropriate sensor only. Check accuracy again. If the system is still out of tolerance, carry out Command 6 (Pressure), and Command 7 (Radius Moment). This should correct any inaccuracy in the RCI 510/400 Calibration procedure.

## Extension Reel Replacement

If using the rectangular-type extension reel, replace the Extension Reel Assembly using the procedure that follows. If using the newer style round extension reel, replace the Extension Reel assembly following the instructions in the Extension Reel Specification/Installation Data manual that is appropriate to the Extension Reel used.

1. Fully retract the main boom.
2. Disconnect the connector to the Anti Two-Block switch and remove the cable from the main boom head anchor. Allow the cable to retract onto the reel. Take care not to let the cable retract too rapidly.
3. Remove the Extension Reel Cable connector.
4. Remove the mounting bolts securing the extension reel to the boom. Remove the reel.
5. Mount the new reel to the boom, secure with the 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 12 ft. 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 3 ft. 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 Anti Two-Block 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 3 clicks clockwise until the length display reads the retracted boom length.
12. Replace the Extension Reel Cover, securing it with the four screws.

13. Extend and retract the main boom and ensure that the boom length reading on the display is correct.

## Boom Angle Sensor Replacement

To replace the boom angle sensor that is fitted inside the extension reel, use the following procedure:

1. With the power off, remove the 4 bolts holding the cover of the extension reel 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 a 60° angle and verify the angle with an inclinometer. While viewing the display, adjust the sensor until the display reads 60°. Tighten the mounting bolts.
5. Place the boom in a horizontal position. With an inclinometer, verify that the boom angle is at zero degrees.
6. Verify that the displayed boom angle reads [zero] 0° ± 0.5°.

## Executive Rom Chip Replacement

### ⚠ WARNING

**THE COMPUTER IS AN ESD SENSITIVE DEVICE. YOU MUST MAINTAIN A STATIC SAFE WORK ENVIRONMENT. USE A FIELD SERVICE GROUNDING KIT OR OTHER STATIC DISSIPATIVE PRODUCT WHILE HANDLING THE COMPUTER AND/OR COMPONENTS.**

The Executive ROM Chip contains the main program data that the computer uses to function and must be specific to the System.

1. Access the Processor Board, refer to "The Processor Board And The Termination Board" on page 29.
2. With the power off, remove IC2, the Executive ROM Chip, from its socket. Refer to Figure 18 on page 29.
3. Install the new Executive ROM Chip into the socket. Make certain the notch in the chip is lined up with the notch in the socket and all pins are properly inserted.

## Personality Rom Chip Replacement

### ⚠ WARNING

**THE COMPUTER IS AN ESD SENSITIVE DEVICE. YOU MUST MAINTAIN A STATIC SAFE WORK ENVIRONMENT. USE A FIELD SERVICE GROUNDING KIT OR OTHER STATIC DISSIPATIVE PRODUCT WHILE HANDLING THE COMPUTER AND/OR COMPONENTS.**

The Personality ROM Chip must be the proper chip for the particular crane serial number. This chip contains calibration data that is unique to each crane.

1. Access the Processor Board, refer to "The Processor Board And The Termination Board" on page 29.
2. With the power off, remove IC7, the Personality ROM Chip, from its socket. (Refer to General Chip Removal and Installation in this manual).
3. Install the new Personality ROM Chip into the socket. Make certain the notch in the chip is lined up with the notch in the socket and all pins are properly inserted.

## Duty Rom Chip Replacement

### ⚠ WARNING

**THE COMPUTER IS AN ESD SENSITIVE DEVICE. YOU MUST MAINTAIN A STATIC SAFE WORK ENVIRONMENT. USE A FIELD SERVICE GROUNDING KIT OR OTHER STATIC DISSIPATIVE PRODUCT WHILE HANDLING THE COMPUTER AND/OR COMPONENTS.**

The Duty ROM Chip must be specific to the load chart used in the crane. This chip contains a copy of the load chart and must match the load chart in the crane.

1. Access the Processor Board, refer to "The Processor Board And The Termination Board" on page 29..
2. With the power off, remove IC3, the Duty ROM Chip from its socket. Refer to Figure 18 on page 29.
3. Install the new Duty ROM Chip in the socket. Ensure that the notch in the chip is lined up with the notch in the socket and all pins are properly inserted.

**NOTE** Replacement of the Executive or Duty ROM Chip does NOT necessitate the re-calibration of the system.

**NOTE** Replacement of the Personality ROM Chip does NOT necessitate re-calibration of the system if the new Personality ROM Chip is an exact duplicate of the original. If a copy of the Personality Chip is not available, the System will need to be completely re-calibrated.

## Processor Board Replacement

### ⚠ WARNING

**THE COMPUTER IS AN ESD SENSITIVE DEVICE. YOU MUST MAINTAIN A STATIC SAFE WORK ENVIRONMENT. USE A FIELD SERVICE GROUNDING KIT OR OTHER STATIC DISSIPATIVE PRODUCT WHILE HANDLING THE COMPUTER AND/OR COMPONENTS.**

1. With the power off, access the Processor Board, refer to "The Processor Board And The Termination Board" on page 29.
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. These locking tabs must be pushed away from the cable to disconnect the cable. As the locking tabs are pushed, the connector will come loose 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 the correct type. These three chips are:

- 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.

6. Install the:
  - Executive ROM Chip
  - Duty ROM Chip
  - Personality ROM Chip
7. Place the computer assembly into the computer box and tighten the two mounting screws; be careful to allow access to the ribbon cables.
8. Reconnect the two ribbon cables. Fully engage the connector and locking tabs.
9. Replace the Computer Box cover and secure with the four screws.

## Computer Box Replacement

### **⚠ WARNING**

**THE COMPUTER IS AN ESD SENSITIVE DEVICE. YOU MUST MAINTAIN A STATIC SAFE WORK ENVIRONMENT. USE A FIELD SERVICE GROUNDING KIT OR OTHER STATIC DISSIPATIVE PRODUCT WHILE HANDLING THE COMPUTER AND/OR COMPONENTS.**

Terminal Board and Box Only

Use the Processor Board from the original box.

1. Remove the processor board.
2. Label each cable. Refer to Figure 19 on page 29. Then label each wire with its terminal location. Remove cable from 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.

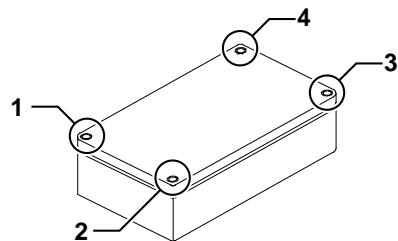
## Chip Removal And Installation

### Removing the Existing Chips

#### ⚠ WARNING

THE COMPUTER IS AN ESD SENSITIVE DEVICE. YOU MUST MAINTAIN A STATIC SAFE WORK ENVIRONMENT. USE A FIELD SERVICE GROUNDING KIT OR OTHER STATIC DISSIPATIVE PRODUCT WHILE HANDLING THE COMPUTER AND/OR COMPONENTS.

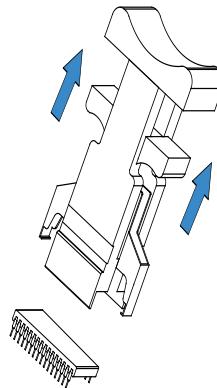
1. Using a #3 Phillips screwdriver, loosen the four screws at the corners of the computer box. Remove the lid and set aside carefully so as not to damage the seal.
2. Locate the program chip on the computer board. Refer to Figure 18 on page 29.



#### ⚠ WARNING

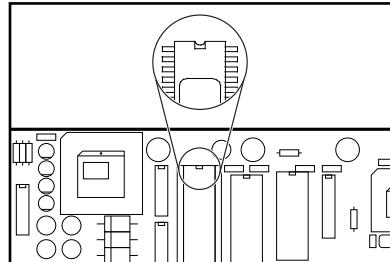
DO NOT USE A SCREWDRIVER, KNIFE, OR ANY OTHER TOOL TO REMOVE THE COMPUTER CHIPS. DOING SO WILL DAMAGE THE CHIPS AND/OR THE COMPUTER CIRCUIT BOARD AND WILL VOID ANY WARRANTY.

3. Position the chip removal tool onto the chip to be removed.
4. Grasp the trigger handles and pull upward.
5. The chip removal tool will automatically secure and remove the chip in one motion.



## Installing the Replacement Chips

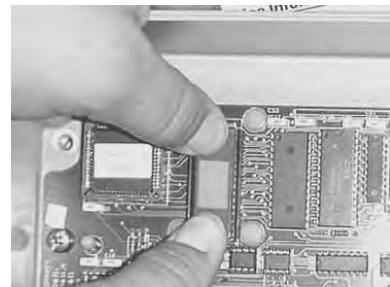
1. Check that the pins of the replacement chip are aligned properly. If any pins are bent, carefully realign them.
2. Ensure that the chip is oriented correctly.



3. Place the chip into the socket, do not apply pressure at this time. Make sure all the pins of the chip are aligned with the respective holes in the socket (see photo).



4. Using a finger from each hand, apply equal pressure to both ends of the chip to fully seat it into the socket (see photo).
5. Reinstall the cover and tighten the screws.
6. Reconnect the computer to the electrical supply.



## No Duty Found

The system requires the same information that 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 appear. 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. Upon correction of the sensor fault, the system will again be able 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 re-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 is associated with the 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. The Duty chip can be replaced without the need to re-calibrate. This chip 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 multiple configurations other than what is necessary for a particular crane. Fly or jib options that are not supplied with the crane will not show up in the Crane Set Up 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. This can be done by removing the four screws securing the display to the dashboard and unscrewing the cable from the back of the display. Connect the display cable to the new display, install it into the dashboard, and secure with the four mounting screws.

# Component Layout

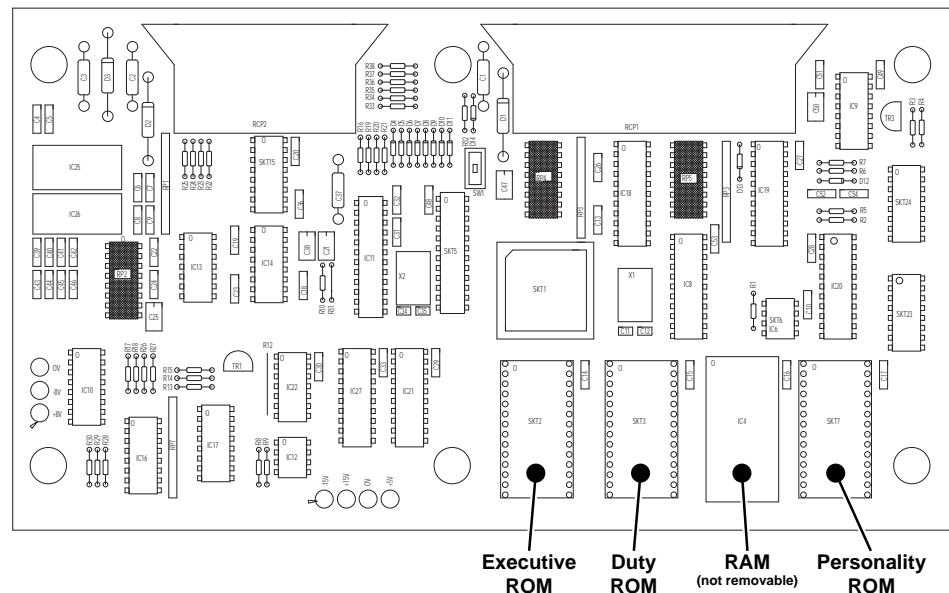


Figure 18 - Processor Board Layout

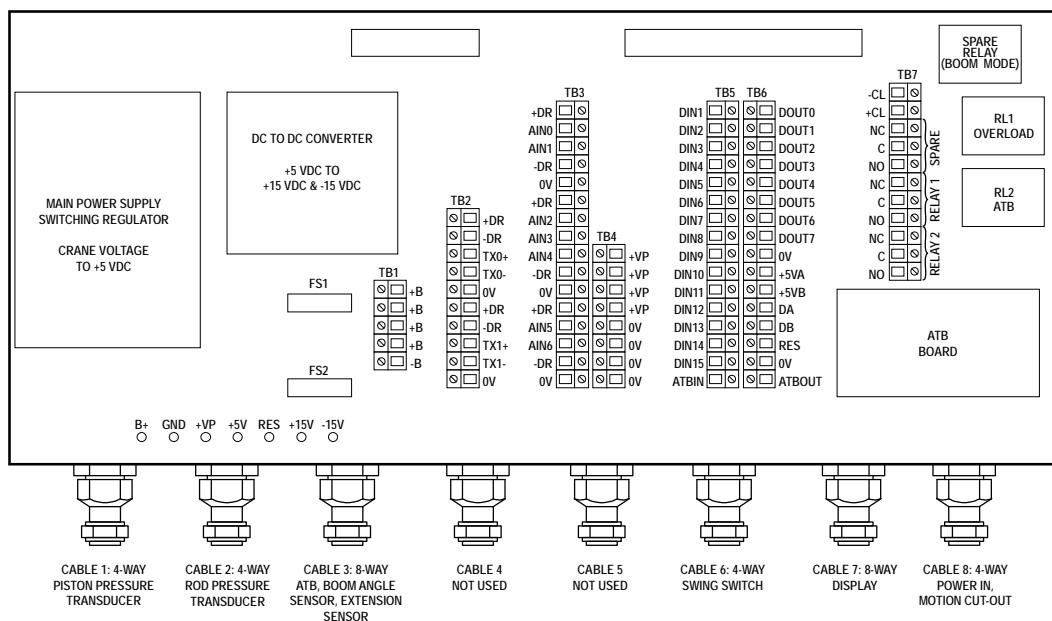


Figure 19 - Termination Board Layout

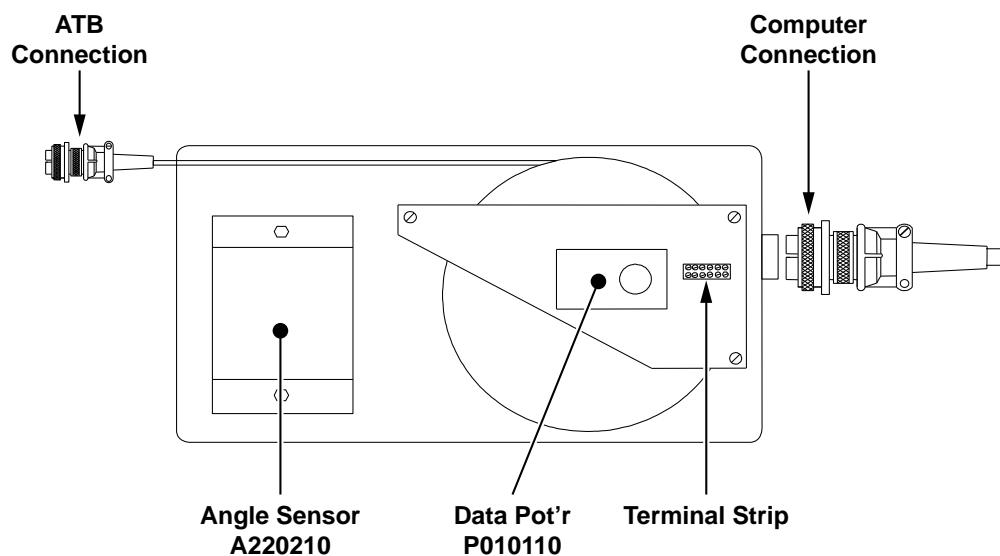


Figure 20 - Extension Reel Layout







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