



HIRSCHMANN

PAT

**LENGTH-ANGLE-RADIUS-LOAD
INDICATING SYSTEM**

EI65/0005



OPERATOR'S, INSTALLATION, CALIBRATION, SERVICE MANUAL

P/N 056-065-190-200, Rev. -, 12/05/05

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1. GENERAL INFORMATION

The PAT Length-Angle-Radius-Load Indicator System EI65 has been designed to provide the crane operator with the essential information required to enable the machine to be used within its design parameters. The EI65 System indicates the length and angle of the boom, tip height, working radius and the total calculated weight being lifted by the crane.

Using various sensing devices, the EI65 System warns the crane operator of certain approaching hazardous conditions, which could occur during the operation of the crane.

The purpose of this Operator's Manual is to provide information to help the crane operator operate, maintain and troubleshoot the PAT System.

The manual contains the system description, operating, and calibration information.



Always refer to operational instructions and load charts provided by the crane manufacturer for specific crane operation and load limits.

2. WARNINGS

- The EI65 is an operational aid that warns a crane operator of certain approaching hazardous conditions, which could cause damage to equipment and personnel.
- The device is not, and shall not be, a substitute for good operator judgment, experience and use of accepted safe crane operating procedures.
- The responsibility for the safe operation of the crane shall remain with the crane operator who shall ensure that all warnings and instructions supplied are fully understood and observed.
- Prior to operating the crane, the operator must carefully and thoroughly read and understand the information in this manual to ensure that he knows the operation and limitations of the indicator and crane.
- Proper functioning is dependent upon proper daily inspection and observations of the operating instructions set forth in this manual.

3. SYSTEM DESCRIPTION

The PAT EI65 System consists of an operating console with a central microprocessor unit, length/angle sensor, force transducers and anti-two block switches.

Boom length and boom angle is registered by the length/angle sensor mounted inside the cable reel, which is mounted on the boom. The boom length is measured by the cable reel cable, which also serves as an electrical conductor for the anti-two block switches.

The crane load is measured by running line tensiometers attached to the upper side of the boom.

3.1 System Function

After ignition of the engine, the system starts with an automatic test of all lamps, the audible alarm and the complete system.

After the system has passed through the system test without errors, the system will request the operator to confirm the boom and jib configuration data. This allows the operator to compare the system configuration with the actual crane configuration (Refer Section 4.1). After the operator confirms the system configuration, the console will indicate on the display (13), the actual load, tip height, boom length, boom angle, and radius. If an error occurs, refer to Section 8 and the error code list.

In case of a lattice boom crane or if the crane is equipped with a jib, the operator has to confirm the boom and jib configuration data after the system test and before normal operation (refer to Section 4

Figure 1: PAT System EI65 Components of the Telescopic Crane

1. Console
2. Cable Reel
3. Linerider or Force Transducer *
4. A2B Switch

* The load sensor depends on the system and crane options. Refer to Installation Manual 031-300-190-008 for system kit options.

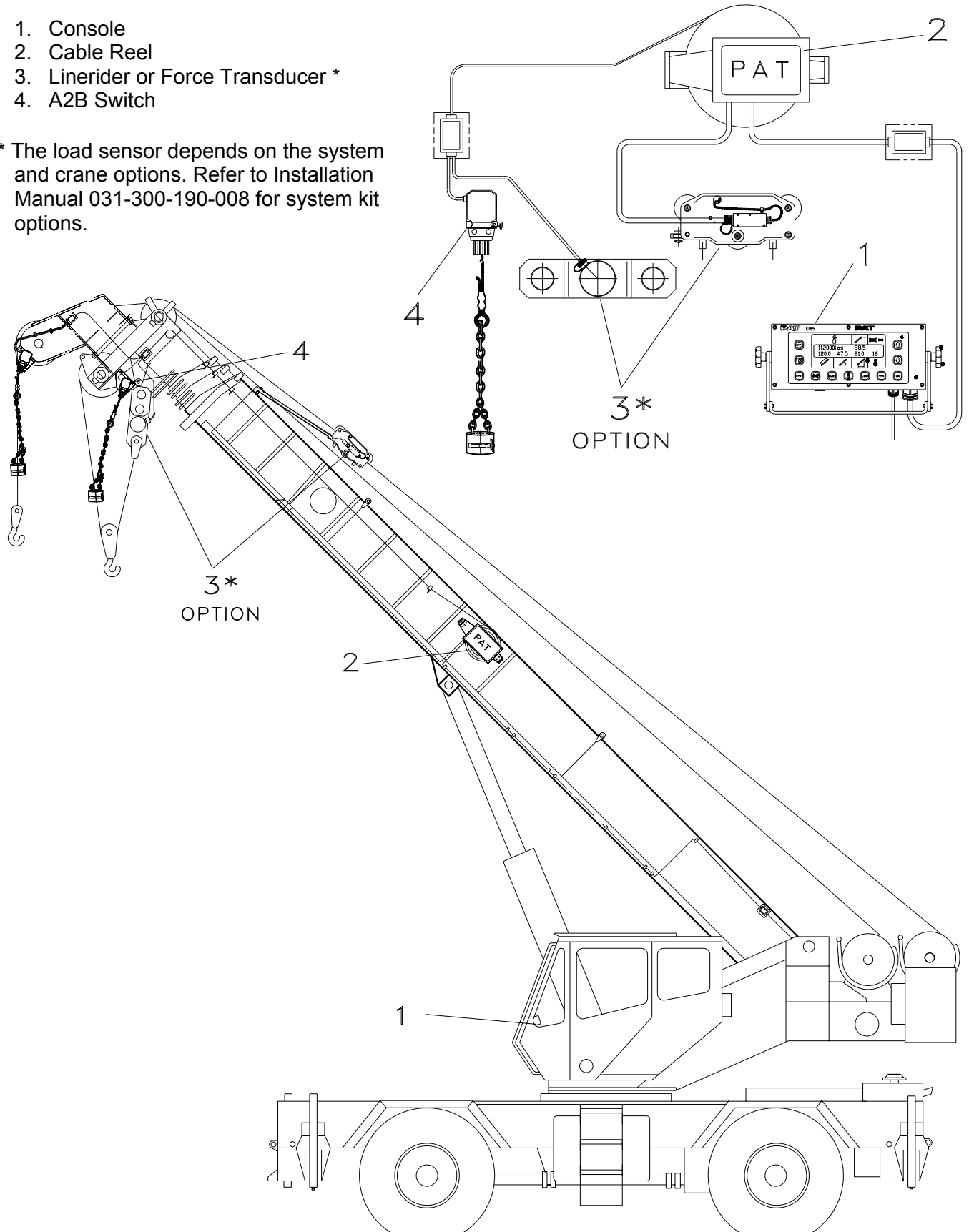
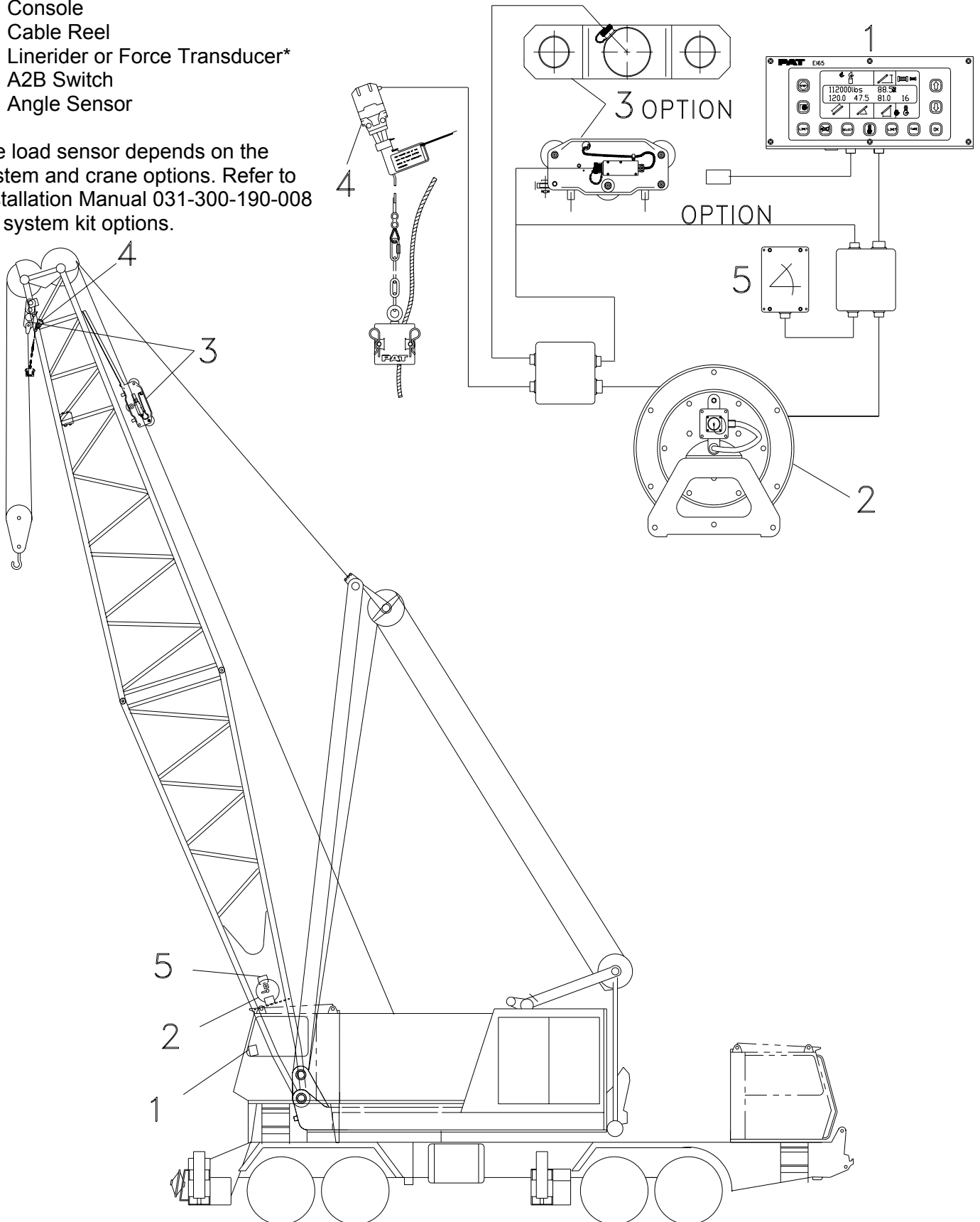


Figure 2: PAT System E165 Components of the Lattice Crane

1. Console
2. Cable Reel
3. Linerider or Force Transducer*
4. A2B Switch
5. Angle Sensor

* The load sensor depends on the system and crane options. Refer to Installation Manual 031-300-190-008 for system kit options.



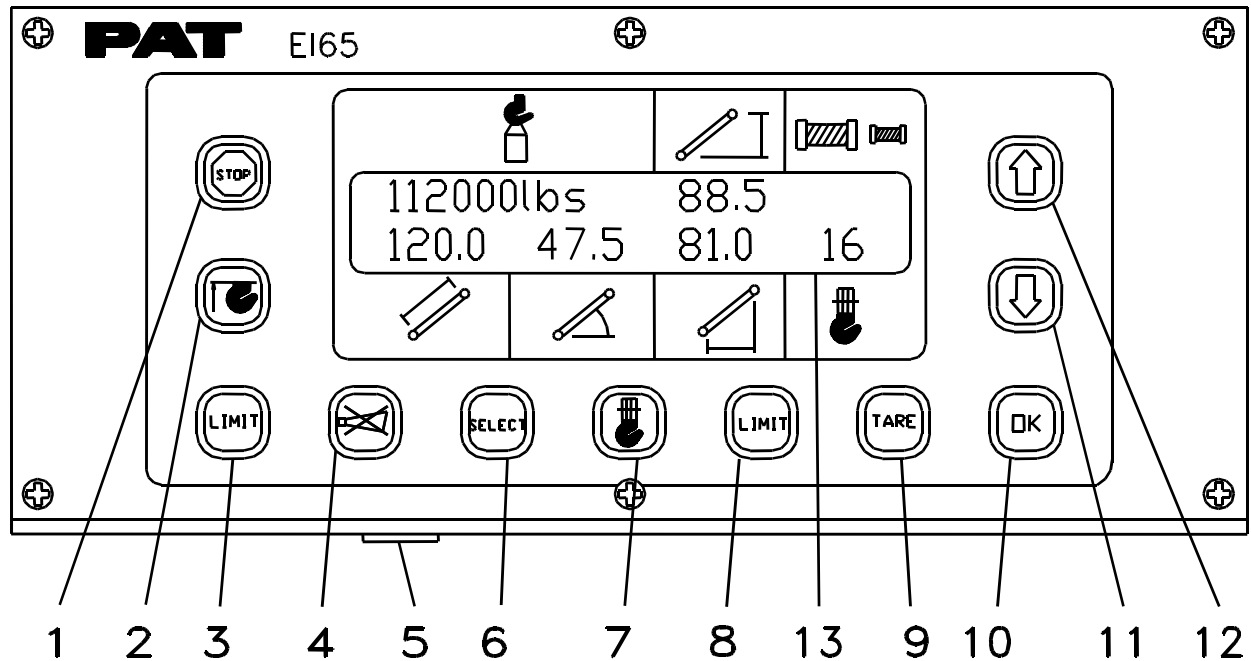
3.2 Operating Console

The console has 2 functions:

- terminal for input of instructions and information to the system by the crane operator
- display of crane data and information

The operating console is located in the operator's cabin in front of the operator. This unit contains different displays and controls, which are described in Section 3.3.

Figure 3. Operating Console

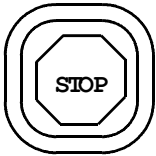


1. Overload Alarm Light
2. Anti-Two Block Alarm Light
3. Limit Alarm Light
4. "Horn OFF" and Alarm Light Button
5. Audible Alarm
6. "SELECT" Button
7. "Reevings/Hoist" Button
8. "LIMIT" Button
9. "TARE" Button
10. "OK" Button
11. "DOWN" Button
12. "UP" Button
13. Data Display

3.3 Control Identification

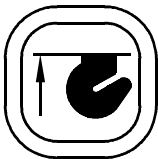
The above figure illustrates the controls and displays of the E165 Operating Console. The numbers of the illustration correspond to the numbers in the following list, which describes the function of each control.

1 Overload Alarm Light



The red Overload Alarm Light (1) will light up when the preprogrammed load limit is reached. At the same time the Audible Alarm (4) will sound and the Limit Alarm Light (3) and the alarm light in the button Horn-Off (5) will light up. The corresponding crane movements will be stopped (Option).

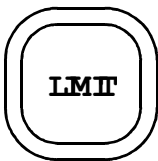
2 Anti-Two Block Warning Light



The red Anti-Two Block Warning Light (2) will light up when the anti-two block limit switch contacts open, indicating that a two-blocking condition is approaching. At the same time the Audible Alarm (4) will sound and the alarm light in the button Horn-Off (5) will light up.

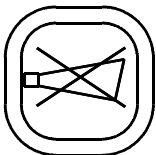
The following crane movements will be stopped simultaneously: hoist up, telescope out, boom down (Option).

3 Limit Alarm Light



The Limit Alarm Light (3) will light up when one of the preprogrammed limits are reached. The limits defined by the operator as minimum and maximum limits for boom angle, boom length, boom height, working radius. At the same time the Audible Alarm (4) will sound and the alarm light in the button Horn-Off (5) will light up. The corresponding crane movements will be stopped (Option).

4 "Horn Off" and Alarm Light Button



The Button "Horn Off" (5) allows the audible alarm to be silenced for approx. 15 seconds by pressing this button. At the same time the corresponding Alarm Light (5) goes out.

5 Audible Alarm

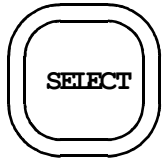


The Audible Alarm (4) is located on the bottom side of the console. It sounds during the following conditions:

- approaching two-block condition
- preset angle, height, length or radius limits are reached
- preset load limit is reached
- system error.

The alarm can be silenced for 15 seconds by pushing button (5).

6 “Select” Button

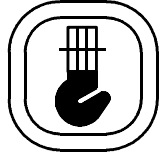


The button “Select” (6) is used for indicating and setting the values of the Operating conditions.

After pressing this button the display indicates a part of the “Select Menu”. It is possible to move through the different points and pages of the menu step by step by pushing the “DOWN” (11) button.

The procedure for indicating and setting the Operating Conditions is described in Section 4.2

7 “Reevings/Hoist” Button



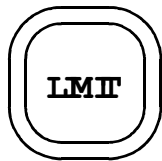
The button “Reevings/Hoist” (7) is used for setting the number of reevings (parts of line) and selecting the hoist winch.

After pressing the button one time the operator is requested to enter the actual number of parts of line by using the button “Up” (12) and “Down” (11).

After pressing the button two times the operator can select the actual hoist winch by using the button “Up” (12) and “Down” (11).

The procedure for setting the reevings and selecting the hoist winch is described in Section 4.2

8 “Limit” Button



The button “Limit” (8) is used for activating the setting procedure of the preset limits. The limits are defined by the operator as minimum and maximum limits for boom length, boom angle, boom height, working radius and maximum limit of load.

The procedure for setting the limits is described in Section 4.3

9 “Tare” Button



The button “Tare” (9) is used to indicate the net load on the display. Net load is the actual load, less lifting tackle and hook block. The button “Tare” has to be activated before lifting.

After pushing the button “Tare” (9) and before lifting the load display will be set to zero (tare) and the lamp in the button lights up. After lifting a load the load display shows the net load (payload).

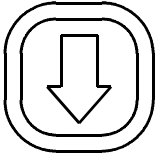
The net load display will return to the normal load display when the button “Tare” (9) is pressed a second time.

10 “OK” Button



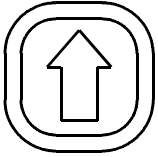
This button (10) is used to confirm values and data, which are used as input for the system. The instruction to use this button will always be given on the display.

11 "Down" Button



The button "Down" (11) is used to get a decrease of a numerical value at the display during the programming and setting procedures and to move through the different menus in "Down" direction. The instruction to use this button will be given on the display.

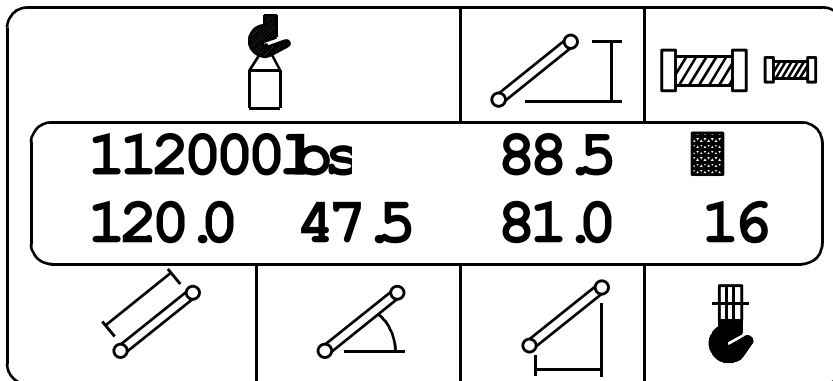
12 "Up" Button



The button "Up" (12) is used to get an increase of a numerical value at the display during the setting procedure of limits and operating conditions.

13 Data Display

The Display (13) will show technical information as well as operating information and instructions for the operator.



During crane operation the readout will display the actual load, the tip height, the boom length, the boom angle, the working radius, the selected hoist winch and the number of reeving (parts of line). In case of a system error an error code is displayed in place of the reeving.

During the setting procedure of the Operating Conditions and the limit setting procedure the display shows the setting values and information for the operator.

4. PROGRAMMING PROCEDURE

During the startup phase the PAT System EI65 automatically starts with a programming procedure which relies on the correct entry by the crane operator.

This procedure consists of three parts:

- Startup Procedure
- Setting operating configuration of the crane
- Setting the preset limits


For simple operation, the computer guides the operator through the procedure step by step. The operator has to read the information displayed and answer questions by using appropriate buttons of the keyboard. During each step of the procedure, particular button lights will come on to identify the possible choices for the step.

4.1 Startup Procedure

After ignition of the engine the system starts the Startup Procedure with a self-test. During the Startup Procedure the crane operator will confirm the preset configuration stored in system memory as described below. The operator will compare the preset operating configuration values with the actual crane configuration.

If there is a difference between the indicated and the actual condition, the operator must correct those values by completing Steps 1 to 15 in Section 4.2.

The system stores the preset values for a minimum of 2 hours when the crane voltage is switched off. After a loss of the preset values, the operator will need to reset these values.

MB 115.0	J1 85.0	
J2 50.0	0J 15.0	1

The display shows the previously programmed boom and jib configuration. The crane operator can compare the preset Operating Configuration Values with the actual crane configuration. To confirm the displayed values, push the button "OK" (10).

To change the configuration values, go to one of the following sections. **If the system configurations are correct**, go to Section 5 PRE-OPERATION INSPECTION.

To change the configuration values go to one of the following sections:

- Section 4.2 will allow the operator to change all crane configurations.
- Section 4.2.1 will allow the operator to quickly change Reeving only
- Section 4.2.2 will allow the operator to quickly to change Hoist selection only.

Note: On a telescopic crane the Startup Procedure will also be skipped, when only a main boom (without jib) is preprogrammed.

4.2 Setting Operating Configuration of the Crane

Note: Only calibrated operating selections, i.e. extension and/or jibs, will appear in the following operating configuration selection.

Step 1

To enter new values the "Select" (6) button has to be pressed.

The DOWN (11) button can be pressed to skip a step in the following procedure. When a particular step is skipped, the configured values of that step remain the same as previously programmed.

Step 2

SELECT BOOM?
PUSH ↓ OR OK

The operator is requested to enter the boom configuration. Press "OK" (10) Button for next step. To continue with the previously entered boom configuration press the DOWN (11) button.

Step 3 to 9 will be skipped, when the button "DOWN" is pressed.

Step 3

MAIN BOOM?
PUSH ↓ OR OK

The operator is requested to press the "DOWN" (11) button if the crane is equipped with a boom extension. If the crane is equipped only with a main boom (without jib or boom extension) the OK (10) button has to be pressed.

Step 5 to 9 will be skipped, when the button "OK" is pressed.

Step 4

For telescopic cranes this step will be skipped.

BOOM LGTH?
PUSH ↓↑ OR OK

The display shows the previously programmed or default length of the main boom. To enter a new main boom length, the operator has to select the value by pressing the "UP" (12) or "DOWN" (11) buttons.

Step 5

This step will be skipped, when there is no whip extension available.

WHIP EXTENSION?
PUSH ↓ OR OK

If the crane is equipped with a whip extension, press the "OK" (10) button. If the crane is not equipped with a whip extension, press the DOWN (11) button.

Step 6 will be skipped, when the whip extension is selected.

Step 6

FIXED EXTENSION?
PUSH ↓ OR OK

If the crane is equipped with an extension or jib, press the "OK" (10) button. If the DOWN (11) button is pushed, the system will return to Step 3, because no extension or jib have been entered.

Step 7

JIB LGTH_1: 45 USE ↓↑ OR OK

The display shows the previously programmed or default length of jib 1. Enter a new jib length, using the “UP” (12) or “DOWN” (11) buttons. If no jib 1 is used the value 0.0 has to be selected.

Note: Jib 1 is a boom extension with fixed length and without offset angle.

Confirm jib 1 length by pressing the “OK” (10) button.

Step 8

JIB LGTH_2: 25 USE ↓↑ OR OK

The display shows the previously programmed or default length of jib 2. Enter a new jib length, using the “UP” (12) or “DOWN” (11) buttons. If no jib 2 is used the value 0.0 has to be selected.

Note: Jib 2 is a boom extension with fixed length and with offset angle.

Confirm jib 2 length by pressing the “OK” (10) button.

Step 9

JIB OFFSET_2: 15 USE ↓↑ OR OK

The display shows the previously programmed or default offset of jib 2. Enter a new jib offset, using the “UP” (12) or “DOWN” (11) buttons.

Confirm jib 2 offset by pressing the “OK” (10) button.

Step 10

This step will be skipped, if the crane is not equipped with an Auxiliary Hoist.

HOIST SELECT? PUSH ↓ OR OK

The crane operator is requested to select hoist or winch that is currently being used. Press Button “OK” (10) for next step. If the operator wants to continue with the previously used or default hoist, press the “DOWN” (11) button.

Step 11 will be skipped, when the button “DOWN” is pressed.

Step 11

MAIN HOIST? PUSH ↓ OR OK

Use the “DOWN” (10) button to toggle between the Main Hoist or the Auxiliary Hoist. Confirm the selection by pressing the “OK” (10) button.

AUXILIARY HOIST? PUSH ↓ OR OK

Step 12

REEVING?
PUSH ↓ OR OK

Press Button "OK" (10) to enter the number of reevings (parts of line) being used. If the operator wants to continue with the previously programmed or default number of reevings, press "DOWN" (11) button.

Step 13 will be skipped, when the button "DOWN" is pressed.

Step 13

PARTS OF LINE: 1
PUSH ↓↑ OR OK

The display shows the previously programmed or default number of reevings (parts of line). To change the parts of line, use the "UP" (12) or "DOWN" (11) buttons. If the operator wants to continue with the displayed number of reevings (parts of line), confirm by pressing the

"OK" (10) button.

Step 14

SHOW SELECTION?
PUSH ↓ OR OK

If you would like to review the selection made in the programming procedure, press "OK" (10) button. The display will show jib length and offset, check correct and press "OK". If no jibs were selected the Exit

screen will appear.

Step 15

EXIT!
PUSH ↓ OR OK

The Setting Procedure is completed. The crane operator has the possibility to accept the conditions programmed on Step 1 to 13, or to correct the values.


For correction of the preset condition press the "DOWN" (11) button and correct the selection you have made in this programming procedure. After correcting the selection, return to the EXIT screen to accept and exit.

Press the "OK" (10) button.

The operating screen will be displayed, which shows the measured crane data. Complete Section 5. PRE-OPERATION INSPECTION to ensure the data shown is correct.

4.2.1 Setting of Reeving

The operator can activate the setting procedure by pushing the button “Reeving/Hoist Winch” (7).

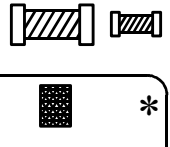

 After pushing the button one time an asterisk will appear on the display beside the number of reeving, indicating that the procedure of setting the reeving is activated. To enter a new number of reeving the operator has to select the value by pushing the buttons “UP” (12) or “DOWN” (11).

If the operator wants to continue with the displayed number of reeving (parts of line) he has to confirm by pushing the button “OK” (10).

After pushing the button “OK” (10) the procedure for Number of Reeving is completed. The operating screen will be displayed, which shows the measured crane data. Complete Section 5. PRE-OPERATION INSPECTION to ensure the data shown is correct.

4.2.2 Selecting the Hoist Winch

The procedure for selecting the hoist winch can be activated by the operator by pushing the button “Reeving/Hoist Winch” (7) two times.


 After pushing the button two times an asterisk will appear on the display beside the symbol for the hoist winch. Select either the main hoist “UP” (12) or the auxiliary hoist using the button “DOWN” (11).

Select the hoist or winch that is currently being used, and confirm by pushing the “OK” (10) button. The operating screen will be displayed, which shows the measured crane data. Complete Section 5. PRE-OPERATION INSPECTION to ensure the data shown is correct.

4.3 Activating and Setting of Preset Limits

The PAT System EI65 is equipped with the following presets:

- limit for maximum hook load
- limits for maximum and minimum boom angle, boom length and working radius.

The operator has the option to activate a maximum and minimum limit of one of the above geometric dimensions.

When a limit is activated, it is identifiable by a blinking colon on the working screen for the corresponding geometric data displayed.

The operator has to read the information displayed and is instructed to answer questions by using appropriate buttons of the keyboard as defined in the following procedures. During the Setting Procedure, the lamp in the particular button lights up to indicate button option. When the system is longer than 2 hours without supply voltage, the preset values may be lost and will reset to the to the maximum or minimum limits.

To activate a preset limit press the LIMIT (8) button.

Scroll through the following limits by pressing the "DOWN" (11) button this will allow you to select one of the following presets:

4.3.1 Length Limit

4.3.2 Angle Limit

4.3.3 Radius Limit

4.3.4 Height Limit

4.3.5 Load Limit

4.3.6 EXIT Limit; exits the limit settings

4.3.7 Default Limits; set the all limits at a maximum and minimum

4.3.1 Setting of Boom Length Presets

Step 1

LENGTH LIMIT?
PUSH ↓ OR OK

This message appears after pushing the "LIMIT" (8) button and pressing the "DOWN" (11) button to scroll through the limits. To set a minimum and maximum boom length limit press the "OK" (10) button.

Step 2

MIN. LIMIT: 10
USE ↑↓ OR OK

The minimum boom length preset value is displayed, use the "UP" (12) and "DOWN" (11) buttons to change the displayed value to your desired limit. Push Button "OK" (10) for next step.

Step 3

MAX. LIMIT:	90
USE ↑↓ OR OK	

The maximum boom length preset value is displayed, use the “UP” (12) and “DOWN” (11) buttons to change the displayed value to your desired limit. Push Button “OK” (10) for next step.

Step 4

MAX. LIMIT:	90
MIN. LIMIT:	10

Verification of the previously set values for maximum and minimum boom length presets are displayed. If the value are incorrect press “OK” (10) button and restart the limit preset procedure. Pressing “OK” will store the preset values and return to the working screen.

4.3.2 Setting of Boom Angle Presets**Step 1**

ANGLE LIMIT?	
PUSH ↓ OR OK	

This message appears after pushing the “LIMIT” (8) button and pressing the “DOWN” (11) button to scroll through the limits. To set a minimum and maximum boom angle limit press the “OK” (10) button.

Step 2

MIN. LIMIT:	-15
USE ↑↓ OR OK	

The minimum boom angle preset value is displayed, use the “UP” (12) and “DOWN” (11) buttons to change the displayed value to your desired limit. Push Button “OK” (10) for next step.

Step 3

MAX. LIMIT:	90
USE ↑↓ OR OK	

The maximum boom angle preset value is displayed, use the “UP” (12) and “DOWN” (11) buttons to change the displayed value to your desired limit. Push Button “OK” (10) for next step.

Step 4

MAX. LIMIT:	90
MIN. LIMIT:	-15

Verification of the previously set values for maximum and minimum boom angle presets are displayed. If the values are incorrect press “OK” (10) button and restart the limit preset procedure. Pressing “OK” will store the preset values and return to the working screen.

4.3.3 Setting of Boom Radius Presets

Step 1

RADIUS LIMIT?
PUSH ↓ OR OK

This message appears after pushing the "LIMIT" (8) button and pressing the "DOWN" (11) button to scroll through the limits. To set a minimum and maximum boom radius limit press the "OK" (10) button.

Step 2

MIN. LIMIT: 0.0
USE ↑↓ OR OK

The minimum boom radius preset value is displayed, use the "UP" (12) and "DOWN" (11) buttons to change the displayed value to your desired limit. Push Button "OK" (10) for next step.

Step 3

MAX. LIMIT: 190
USE ↑↓ OR OK

The maximum boom radius preset value is displayed, use the "UP" (12) and "DOWN" (11) buttons to change the displayed value to your desired limit. Push Button "OK" (10) for next step.

Step 4

MAX. LIMIT: 190
MIN. LIMIT: 0.0

Verification of the previously set values for maximum and minimum boom radius presets are displayed. If the values are incorrect press "OK" (10) button and restart the limit preset procedure. Pressing "OK" will store the preset values and return to the working screen.

4.3.4 Setting of Boom Height Presets

Step 1

HEIGHT LIMIT?
PUSH ↓ OR OK

This message appears after pushing the "LIMIT" (8) button and pressing the "DOWN" (11) button to scroll through the limits. To set a minimum and maximum boom height limit press the "OK" (10) button.

Step 2

MIN. LIMIT: 0.0
USE ↑↓ OR OK

The minimum boom height preset value is displayed, use the "UP" (12) and "DOWN" (11) buttons to change the displayed value to your desired limit. Push Button "OK" (10) for next step.

Step 3

MAX. LIMIT: 190
USE ↑↓ OR OK

The maximum boom height preset value is displayed, use the "UP" (12) and "DOWN" (11) buttons to change the displayed value to your desired limit. Push Button "OK" (10) for next step.

Step 4

MAX. LIMIT:	190
MIN. LIMIT:	0.0

Verification of the previously set values for maximum and minimum boom height presets are displayed. If the values are incorrect press "OK" (10) button and restart the limit preset procedure. Pressing "OK" will store the preset values and return to the working screen.

4.3.5 Setting of Boom Load Presets**Step 1**

LOAD LIMIT? PUSH ↓ OR OK

This message appears after pushing the "LIMIT" (8) button and pressing the "DOWN" (11) button to scroll through the limits. To set a minimum and maximum boom load limit press the "OK" (10) button.

Step 2

MAX. LIMIT: 10000_ USE ↑↓ OR OK

The maximum boom load preset value is displayed, use the "UP" (12) and "DOWN" (11) buttons to change the displayed value to your desired limit. Pressing "OK" will store the preset value and return to the working screen.

4.3.6 Exit Limit Presets

EXIT LIMIT? PUSH ↓ OR OK

This message appears after pushing the "LIMIT" (8) button and pressing the "DOWN" (11) button to scroll through the limits. To exit limit preset press the "OK" (10) button.

4.3.7 Default Limit

DEFAULT LIMIT? PUSH ↓ OR OK

For deactivation and cancellation of the previously programmed limits, press the "OK" (10) button. In this case the system sets all limits on their default values. The Load Limit and Maximum and Minimum Angle Limit are active. All other limits are deactivated.

5. PRE-OPERATION INSPECTION

Prior to operating the crane, the following checks must be made:

1. Check the cabling connecting the various parts of the system for physical damage.
2. Check the anti-two block switches and weights for free movement.



WARNING

The following tests shall be performed with care to prevent damage to the machine or injury to personnel. Proper functioning of the system requires successful completion of these tests before operating the machine.

3. Check the anti two-block alarm light (2) and the audible alarm by performing one of the following tests a, b, or c. If the crane is equipped with a boom extension, perform the test procedure on both the main boom and boom extension anti two-block switches.



WARNING

When checking system the operator must use caution. If the operator cannot see the load handling device approaching the boom nose, he/she shall have an assistant (signal person) watch the load handling device. The operator shall be prepared to stop the machine immediately should the E165 system not function properly by lighting the red warning light, sounding the audible alarm and locking the dangerous crane movements.

- a) Check the anti-two block alarm light (2) and the audible alarm by manually lifting the weight attached to the anti- two block switches.
- b) Slowly raise the main boom hook block to bring it into contact with the switch weight. When the hook block lifts the weight, the audible alarm should sound, the anti-two block alarm light (2) should light and the motion of the hook block should be stopped. Lower the hook block slightly to eliminate this condition.
- c) Then slowly lower or extend the boom to create a potential two-block condition. When the hook block lifts the weight, the audible alarm should sound, the anti-two block alarm light (2) should light and the boom lowering and/or boom extension function should be stopped.

NOTE: If the light and audible alarm do not function as described and the crane movements are not stopped the system is not working properly. The malfunction must be corrected before operating the crane.

4. Check that the display of the main boom length agrees with the actual boom length.
5. Check that the display of the main boom angle agrees with the actual angles.
6. Check that the display of the operating radius of the crane agrees with the actual radius.

7. Check the load display by lifting a load of known weight. The accuracy of the load indication shall be within the tolerance of SAE J376.

Rated loads include the weight of the hook block, slings, and auxiliary load handling devices. Their combined weights shall be subtracted from the listed load capacities as stated on the load capacity chart to obtain the net load to be lifted.



If any of the displays reflects a deviation between displayed and actual values, an authorized PAT service representative shall be called for repair of the system and/or verification of the crane's calibration.



Any structural modifications or changes to the crane shall require verification of the crane's calibration.

6. OPERATION

After completing Section 4 and 5, the crane configuration must match the actual configuration. Once the system is properly set, it is the operator responsibility to be thoroughly familiar with all controls, warning lights, load, length, height, radius and other information on the EI65 console and crane. The operator is responsible for verifying the operating information is correct. Anytime the operator deems necessary; the pre-operational checks in Section 5 should be completed.

7. SERVICE AND MAINTENANCE

Daily maintenance of the system consists of inspecting:

1. The electrical wiring connecting the various parts of the system. If electrical wiring is damaged, it shall be replaced immediately.
2. Check the anti two-block limit switches for freedom of movement.
3. Check the displayed main boom angle agrees with the actual angle.
4. Check the displayed main boom length agrees with the actual length.
5. Grease linerider sheaves.

Other than correcting the problems identified in the Malfunctions Table and replacing faulty mechanical parts and cables, all other repairs shall be performed by PAT Authorized Service Representatives.

8 TROUBLESHOOTING

MB 115.0	J1 85.0	☰
J2 50.0	0J 15.0	E71

In case of a malfunction of the system, a code that identifies the system malfunction will be displayed in the reeving portion of the display.

The error codes listed in the Malfunction Table will identify various faults that can occur with the EI65. Following the Malfunction Table are pages, which explain each fault and describe the action, which shall be, taken to correct the fault.

Faults within the electronic microprocessor shall be repaired by factory trained service personnel. When these faults occur, the competent service organization shall be contacted.

Note: Limits set by the operator will cause the stop light (1) to activate and the alarm (5) to sound.

Malfunction Table

Error code	Reason	Action
11	Operating data in the buffered RAM	Turn on the system again and adjust operating data
21	Crane parameters in the serial EPROM incorrect	Re-calibrate the system
31	Wrong EPROM programming or EPROM defective	Exchange EPROM
51	Short circuit min layer device term 11&12	Check minimum layer device
52	Cable break min layer device term 11&12	Check minimum layer device
53	Short circuit A2B -switch - 2 term 13&14	Check anti-two block system
54	Cable break A2B -switch - 2 term 13&14	Check anti-two block system
55	Short circuit A2B -switch - 1 term 9&10	Check anti-two block system
56	Cable break A2B -switch - 1 term 9&10	Check anti-two block system
•61	Load on the main hoist hook too big	Reduce load on main hoist
•63	Load on the auxiliary hoist hook too big	Reduce load on aux. Hoist
•71	Limit Length - Main - Boom - Max.	Decrease length limit
•72	Limit Length - Main - Boom - Min.	Increase length limit
•73	Limit WG - Main - Boom - Max.	Decrease main boom angle
•74	Limit WG - Main - Boom - Min.	Increase main boom angle
•75	Limit Boom height - Max.	Decrease main boom angle
•76	Limit Boom height - Min.	Increase main boom angle
•77	Limit Working radius - Max.	Increase main boom angle
•78	Limit Working radius - Min.	Decrease main boom angle
81	ADC-Measuring value KMD1 too big	Check zero point in linerider
82	ADC-Measuring value KMD1 too low	Check zero point in linerider
83	ADC-Measuring value KMD2 too big	Check zero point in linerider
84	ADC-Measuring value KMD2 too low	Check zero point in linerider
93	ADC-Measuring value WG1 too big	Check main angle sensor circuit
94	ADC-Measuring value WG1 too low	Check main angle sensor circuit
95	ADC-Measuring value WG2 too big	Check luffing angle sensor circuit
96	ADC-Measuring value WG2 too low	Check luffing angle sensor circuit

- Limits set by the operator refer to Operator's Manual, Section 4.3. Activating and Setting Preset Limits

INSTALLATION Table of Contents

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7. 031 300 31 1211 Wiring Diagram for 14 conductor reel with 1 force sensor	

1. GENERAL INFORMATION

This Installation Handbook will show the approximate location of components and wiring diagrams required for system operation. This handbook has four different system component and wiring diagrams; therefore, use the drawings that match your system, as shown below:

1. 031-300-100-431 EI65 SYSTEM WITH LINERIDER, HYDRAULIC CRANE
 - 031-300-100-233 CONSOLE KIT
 - 031-300-100-234 A2B BOOM COMPONENT KIT
2. 031-300-100-887 EI65 SYSTEM WITH FORCE TRANSDUCER, HYDRAULIC CRANE
 - 031-300-100-233 CONSOLE KIT
 - 031-300-100-366 A2B BOOM COMPONENT KIT
3. 031-300-100-983 EI65 SYSTEM; 1 FORCE SENSOR AND 7 COND. REEL, LATTICE CRANE
4. 031-300-101-211 EI65 SYSTEM; 2 FORCE SENSORS AND 14 COND. REEL, LATTICE CRANE

Prior to starting the installation, it is advised to review the drawings and define the component locations on the crane. The Length-Angle-Radius-Load Indicating System EI 65 must be calibrated after completing installation.

Reference Information to PAT Angle-Length-Radius-Load Indicator System:

EI 65 Operator's Manual: 056-065-190-005.

EI 65 Calibration Manual: 031-300-190-009.

2. WARNINGS

- Always refer to operational instructions and load charts provided by the crane manufacturer for specific crane operation and load limits.
- The Length-Angle-Radius-Load Indicating System EI 65 is not and shall not be a substitute for good operator judgment, experience, or use of acceptable safe operating procedures.
- The operator is responsible for operating the crane within the manufacturer's specified parameters.
- The crane operator shall ensure that all warnings and instructions provided by the manufacturer are fully understood, observed, and remain with the crane.
- Prior to operating the crane, the operator must carefully read and understand the information in the Operator's Handbook so that he knows the operation and limitations of the Length-Angle-Radius-Load Indicating System EI 65.

3. INSTALLATION

Select the correct EI65 system drawings in Appendix A for your component installation and wiring system, as shown below:

Hydraulic Crane

1. 031 300 02 0431 Parts List with linerider
 - 031 300 31 0233 Console wiring diagram
 - 031 300 31 0234 A2B boom component wiring diagram
2. 031 300 02 0887 Parts List with force transducer, hydraulic crane
 - 031 300 31 0233 Console wiring diagram
 - 031 300 31 0366 A2B boom component wiring diagram

Optional diagrams (System additional components available upon request)

- 031 300 10 0657 Parts List - A2B swingaway jib
- 031 300 31 0657 Wiring Diagram - A2B swingaway jib
- 031 300 31 0197 Wiring Diagram - Key switch lockout box

Lattice Crane

3. 031 300 02 0983 Parts List for 7 conductor reel with 1 force sensor
031 300 31 0983 Wiring Diagram for 7 conductor reel with 1 force sensor
4. 031 300 02 1211 Parts List for 14 conductor reel with 2 force sensors
031 300 31 1211 Wiring Diagram for 14 conductor reel with 2 force sensors

Optional jib kits are shown on parts list (the additional components available upon request)



WARNING

CONTACT CRANE MANUFACTURER FOR WELDING INSTRUCTION PRIOR TO WELDING ON BOOM.

Use the drawings in Appendix A to install your system. The next sections give instructions for linerider, length and angle sensors.

4. LINERIDER INSTALLATION

The line tensiometer (linerider) installation will depend on the type of boom. Follow the applicable instructions for a hydraulic (A) or lattice (B) boom.

LINERIDER GENERAL INFORMATION

The linerider is attached to the swing arm mounting bracket as shown in Figure 1. The swing arm assembly has four joints:

1. Vertical movement at the attachment point to the linerider.
2. Horizontal movement of the swing arm.
3. Vertical movement of the swing arm.
4. Swivels horizontally around the mounting bolt.

The mounting bolt secures the swing arm to the machine.

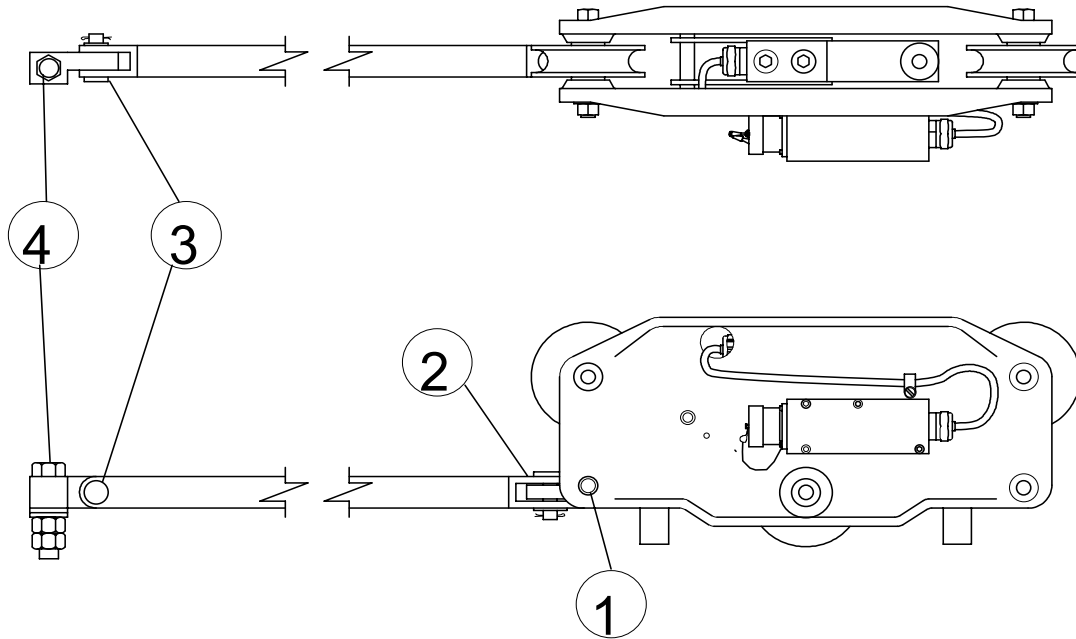


Figure 1. Linerider and Swing Arm.

A. HYDRAULIC BOOM MACHINES

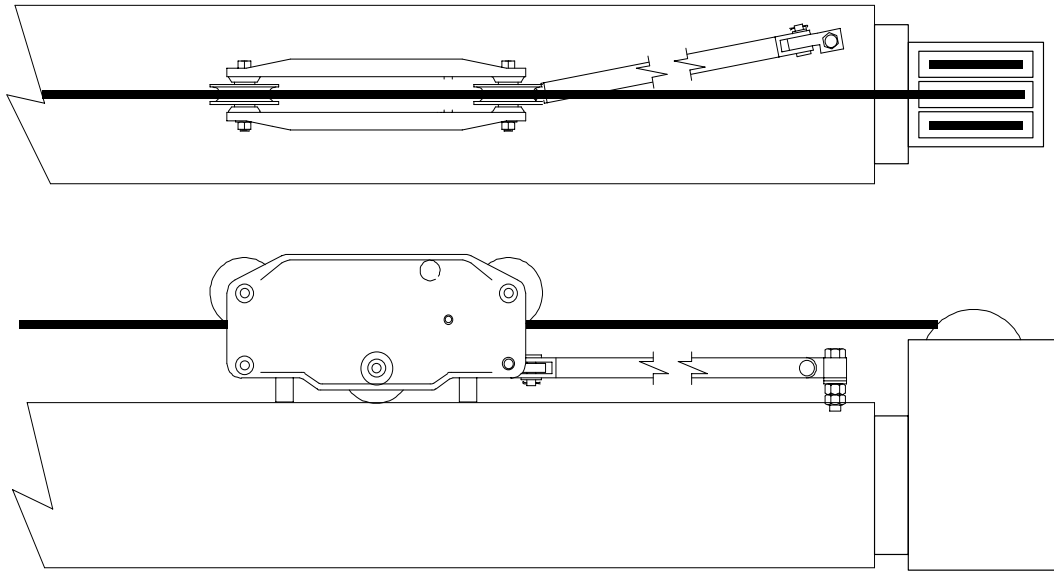


Figure 2. Hydraulic Boom Linerider Installation.



WARNING

CONTACT CRANE MANUFACTURER FOR WELDING INSTRUCTION PRIOR TO WELDING ON BOOM.

- A.1. Affix the bolt at the tip of the base section on the main boom similar to Figure 2. Select a location that the swing arm angle with respect to the boom will not exceed 30°(see Figure 3). The linerider should be located as close to the boom tip as possible.
- A.2 Attach the swing arm to the bolt.
- A.3. Run the hoist line through the linerider.
- A.4. Attach the swing arm to the linerider.
- A.5. Ensure freedom of movement side to side
- A.6. Connect linerider electrically with cable provided.
- A.7. Connect the linerider extension to the console cable at boom base.

B. LATTICE BOOM MACHINES

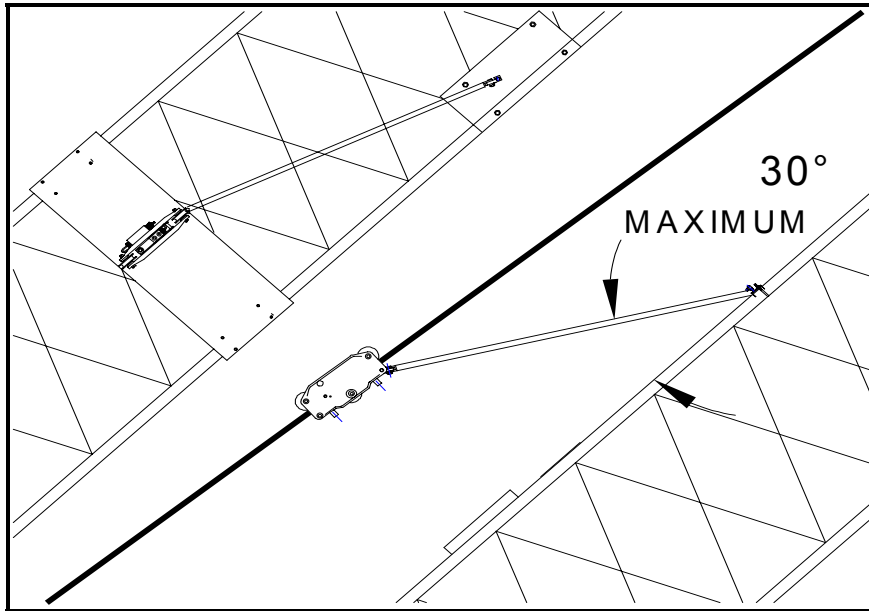


Figure 3. Lattice Boom Linerider Installation.



WARNING

CONTACT CRANE MANUFACTURER FOR WELDING INSTRUCTION PRIOR TO WELDING ON BOOM.

- B.1. Select a location that the swing arm angle with respect to the boom will not exceed 30°(see Figure 3). The linerider should be located as close to the boom tip as possible.
- B.2. Construct two base plates. Size of base plates will be specific to the lattice structure and your selected location.
 1. The first base plate will be attached to the boom with the swing arm bolt affixed to the center of the base plate.
 2. The second base plate will be attached to the boom so that it supports the linerider when not in use.
- B.3. Affix the swing arm bolt to the center of the first base plate.
- B.4. Affix the first base plate to the selected location on the lattice boom.
- B.5. Attach the swing arm to the bolt.
- B.6. Run the hoist line through the linerider.
- B.7. Attach the swing arm to the linerider.
- B.8. Ensure freedom of movement side to side
- B.9. Attach the second base plate to the boom so the linerider rubber supports will touch the plate when there is no load.
- B.10. Connect linerider electrically with cable provided.

5. MECHANICAL ADJUSTMENT OF CABLE REEL SENSORS

HYDRAULIC CRANE

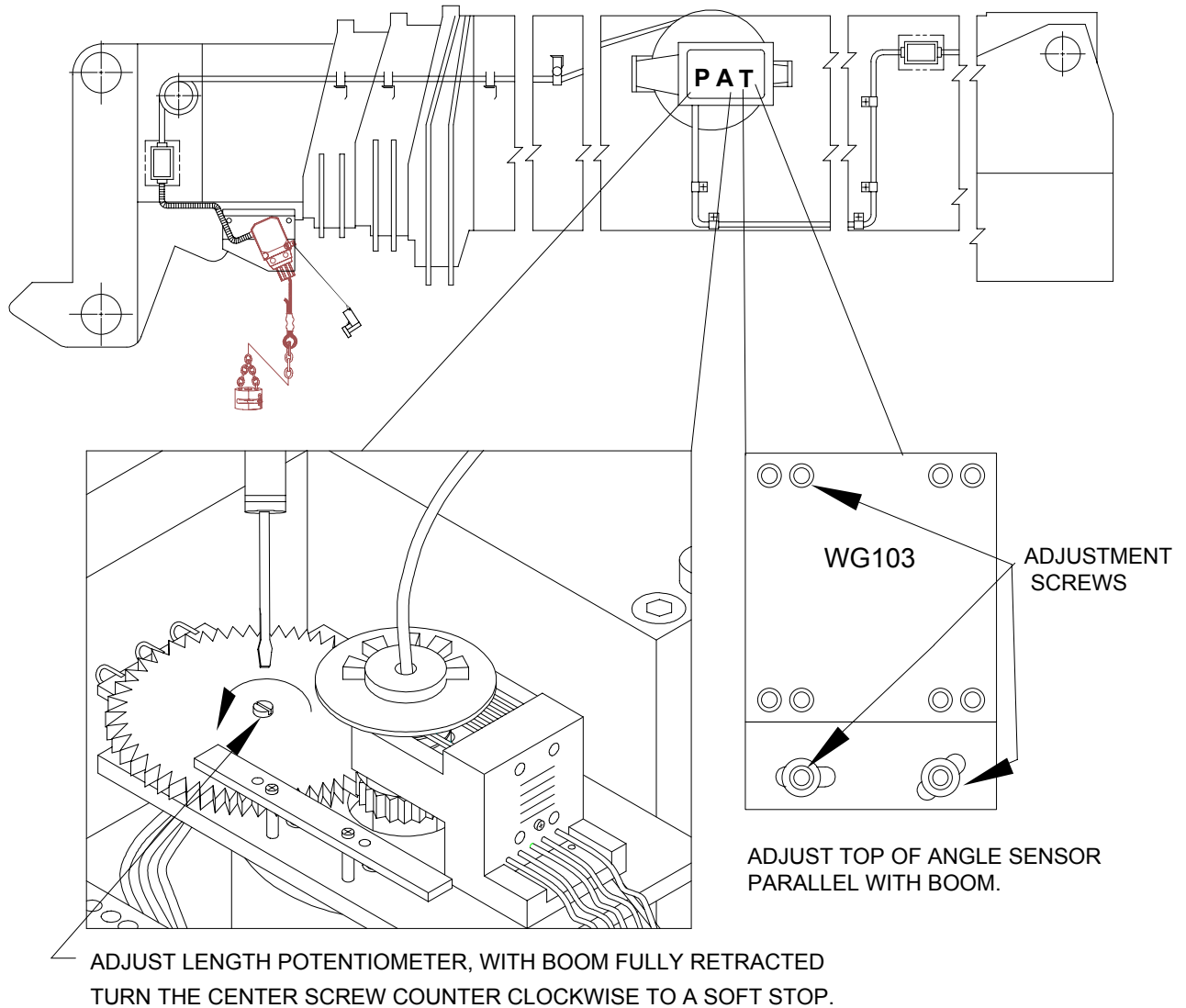


Figure 4. Hydraulic Boom Length and Angle Adjustments.

6. LATTICE CRANE ANGLE SENSOR ADJUSTMENT

The angle ϕ shown in Figure 1 needs to be within $+0, -0.4$ of the actual angle of the boom. Check boom angle at base/heel section only. After adjustment, compare the actual boom angle with the displayed angle at about 0° , 30° and 60° . To comply with the SAE J375 standards the displayed angle must be $+0.0^\circ$ to -2.0° of the actual angle.

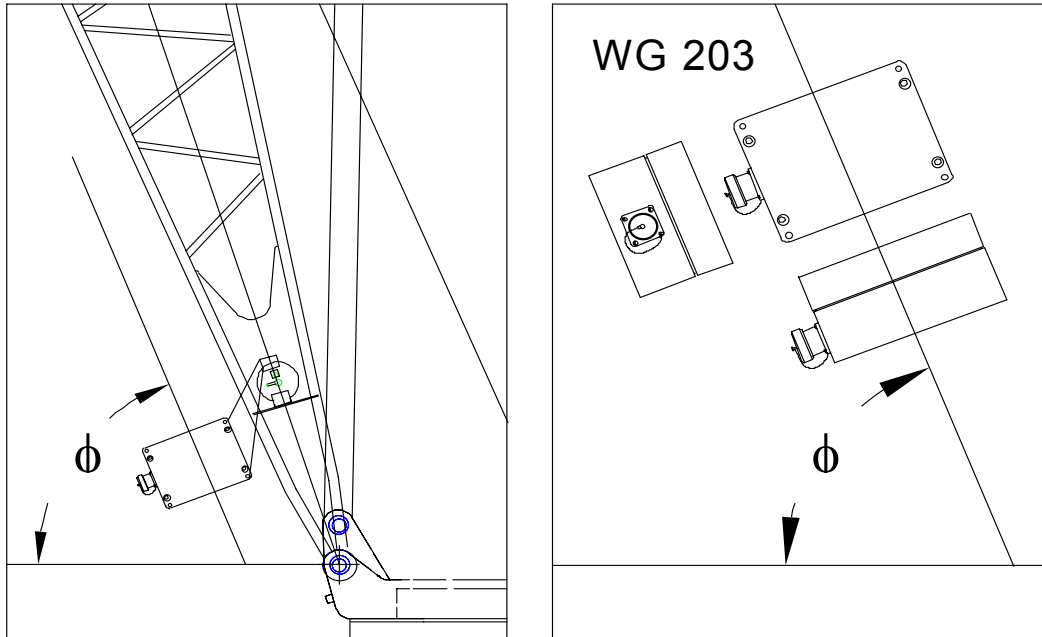


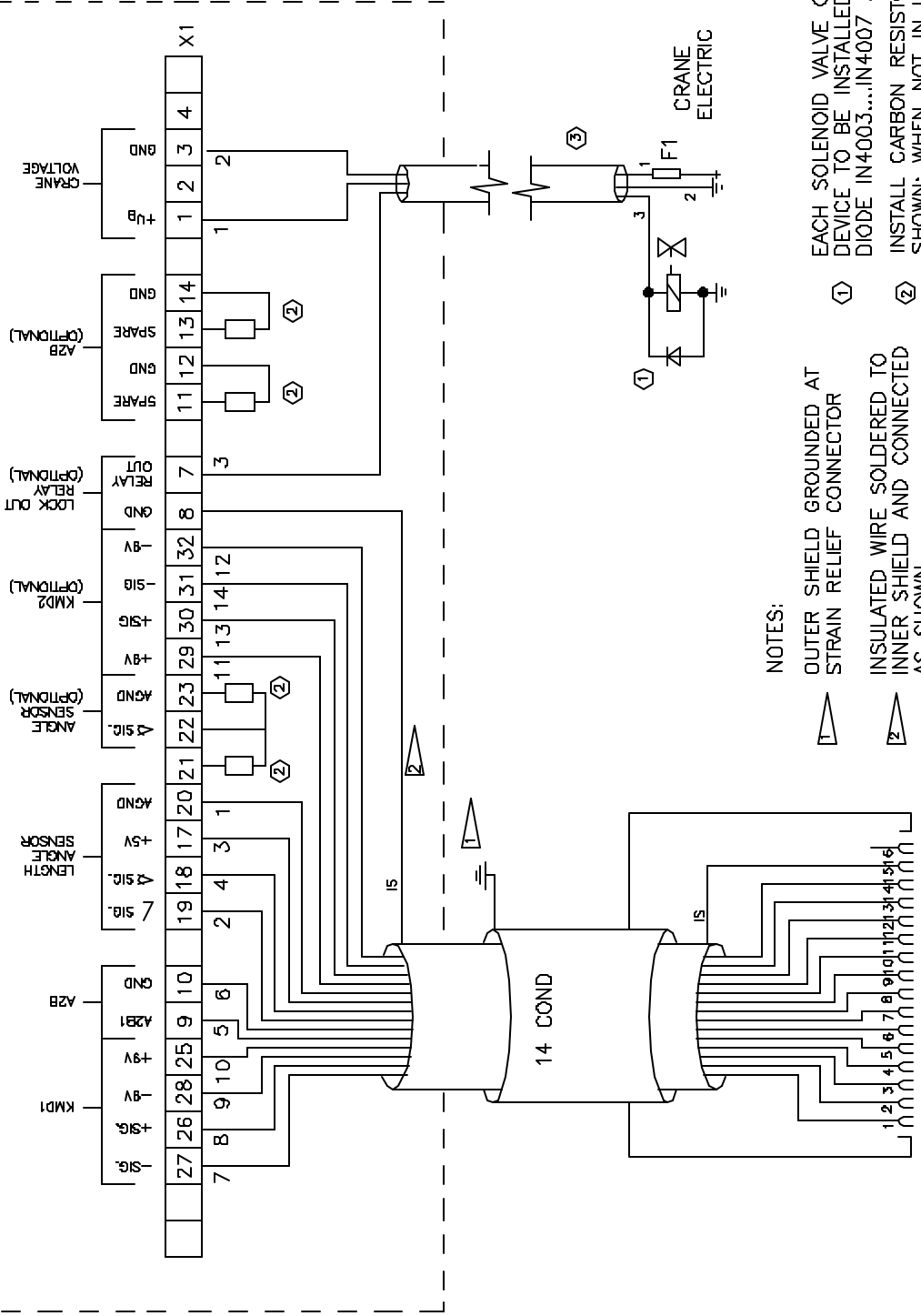
Figure. 4. Lattice Boom Angle Sensor Adjustment.

7. APPENDIX A. SYSTEM DRAWINGS

Drawing list:

- | | | |
|-----|-----------------|--|
| 8. | 031 300 31 0233 | Console wiring diagram |
| 9. | 031 300 31 0234 | A2B boom component wiring diagram – 2 conductor reel |
| 10. | 031 300 31 0366 | A2B boom component wiring diagram – 6 conductor reel |
| 11. | 031 300 31 0657 | Wiring Diagram - A2B swingaway jib |
| 12. | 031 300 31 0197 | Wiring Diagram - Key switch lockout box |
| 13. | 031 300 31 0983 | Wiring Diagram for 7 conductor reel with 1 force sensor |
| 14. | 031 300 31 1211 | Wiring Diagram for 14 conductor reel with 1 force sensor |

EI 65 CONSOLE 056-065-060-005



16 SOCKET PLUG
TO BOOM BASE 16 PIN RECEPTACAL

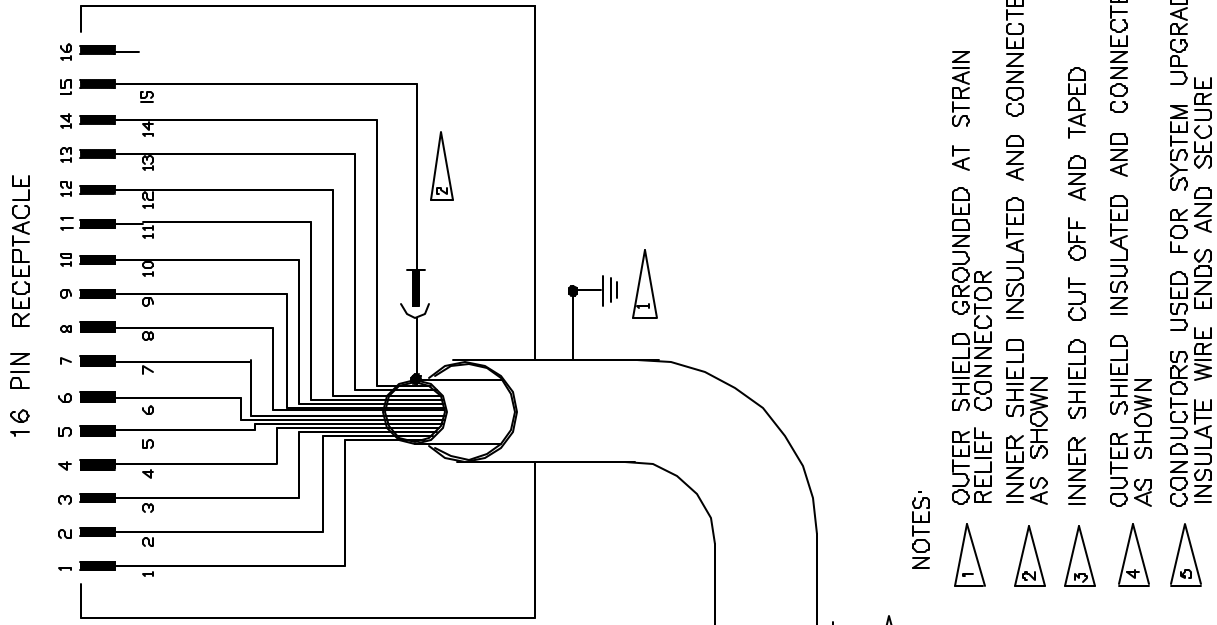
NOTES:

- ① OUTER SHIELD GROUNDED AT STRAIN RELIEF CONNECTOR
- ② INSULATED WIRE SOLDERED TO INNER SHIELD AND CONNECTED AS SHOWN
- ③ EACH SOLENOID VALVE OR MAGNET DEVICE TO BE INSTALLED WITH DIODE IN4003...IN4007 AS SHOWN
- ④ INSTALL CARBON RESISTOR 4K7 AS SHOWN; WHEN NOT IN USE REFER TO CRANE ELECTRIC SCHEMATICS
- KMD1 = FORCE TRANSDUCER/LINE RIDER MAIN HOIST
- KMD2 = FORCE TRANSDUCER/LINE RIDER AUX. HOIST (OPTIONAL)

SEE REFERENCES FOR SYSTEM REQUIREMENTS.
REFERENCES:
CALIBRATION HANDBOOK 031-300-190-009
OPERATION HANDBOOK 056-065-080-005

TERMINAL DESIGNATIONS	
1	+ Battery
2	+ Battery
3	- Battery
4	- Battery
5	A2B Relay output 1
6	A2B Relay output 2
7	Min Wrap Relay output
8	Peripheral ground
9	A2B 1 input
10	A2B Ground
11	A2B 2 input
12	A2B Ground
13	3rd Wrap Switch input
14	3rd Wrap Switch ground
15	Digital input 1
16	Digital input 2
17	+5VDC
18	Main Boom angle Input
19	Main Boom Length Input
20	Analog Ground
21	+5VDC
22	J1b Angle Input
23	Analog Ground
24	Analog Ground
25	+9VDC
26	KMD1 +Signal Input
27	KMD1 -Signal Input
28	-9VDC
29	+9VDC
30	KMD2 +Signal Input
31	KMD2 -Signal Input
32	-9VDC

PAT PAT EQUIPMENT CORPORATION 1665 ORCHARD DRIVE CHAMBERSBURG, PA 17201		EI 65 CONSOLE WIRING DIAGRAM	
REV	ECN	P/N	DRAWN
		031-300-100-233	CHRIS HERTZLER
			APPROVED
			CHRIS HERTZLER
			D5/26/97
			SCALE: NONE
			SHEET: 1 OF 1
GENERAL TOLERANCES X.XX - 0.01 X.XXX - 0.005		SIZE	DWG NO.
		A	031 300 31 0233
PAT Equipment Corporation reserves proprietary rights in this drawing. All rights are reserved. No part of this drawing may be reproduced without the written consent of PAT Equipment Corporation. This drawing is subject to technical modification without prior notice.		C.A.G.E.	79760

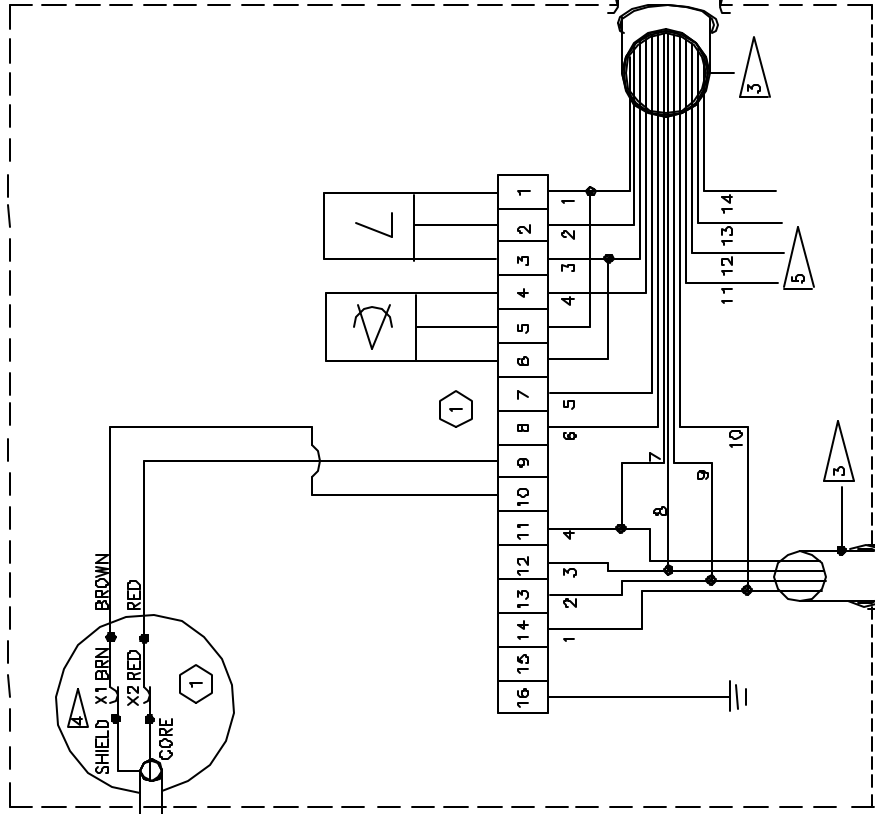


16 PIN RECEPTACLE

NOTES:

- 1 OUTER SHIELD GROUNDED AT STRAIN RELIEF CONNECTOR
- 2 INNER SHIELD INSULATED AND CONNECTED AS SHOWN
- 3 INNER SHIELD CUT OFF AND TAPED
- 4 OUTER SHIELD INSULATED AND CONNECTED AS SHOWN
- 5 CONDUCTORS USED FOR SYSTEM UPGRADES; INSULATE WIRE ENDS AND SECURE

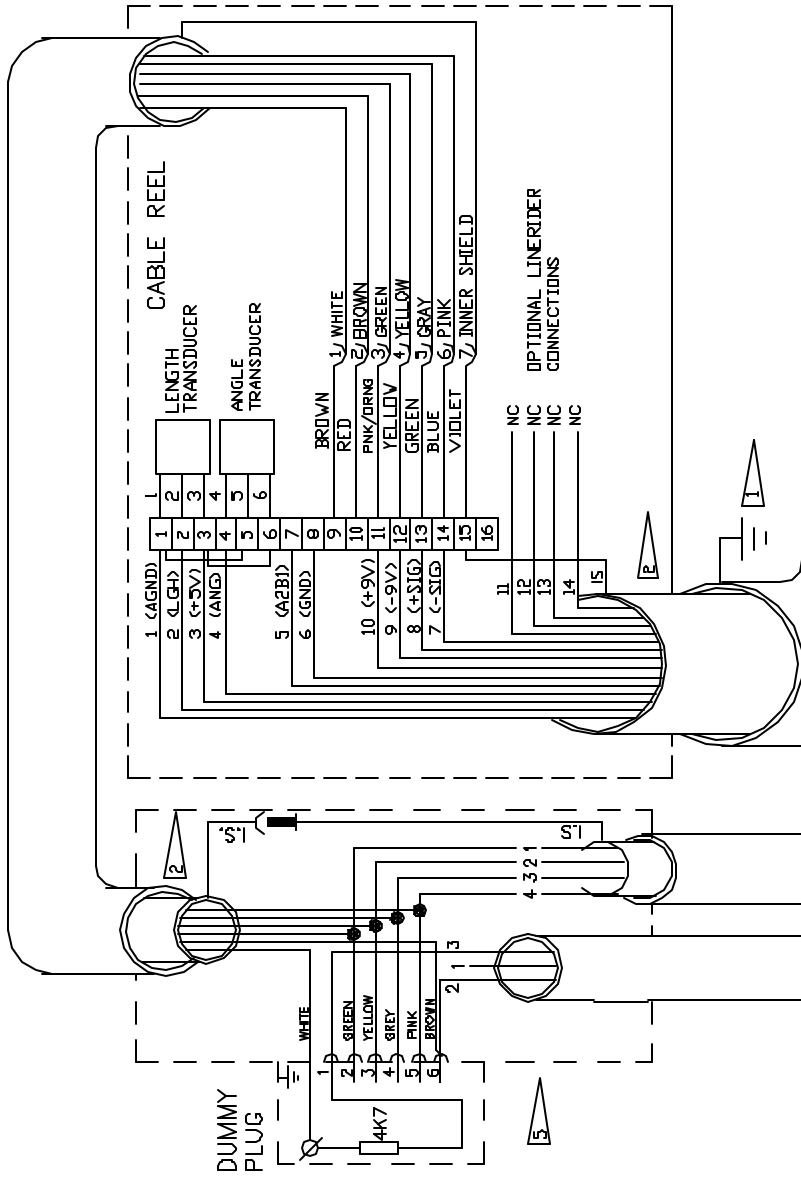
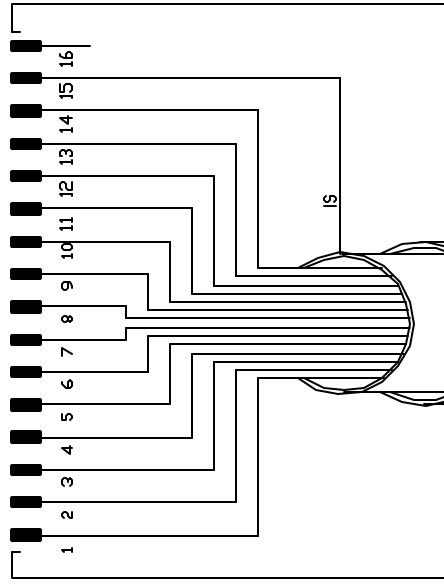
6 SOCKET RECEPTACLE



- 1 PREWIRED BY PAT
- 2 SWITCH PREWIRED AND POTTED
- 3 INSTALL SUPPLIED CONDUIT OVER A2B CABLE
- 4 ANGLE SENSOR
- 5 LENGTH SENSOR

PAT EQUIPMENT CORPORATION 1665 ORCHARD DRIVE CHAMBERSBURG, PA 17201		EI 65 BOOM COMPONENTS	
GENERAL TOLERANCES X.XX - 0.01 X.XXX - 0.005	BY APV DATE	2 CORE LENGTH CABLE REEL	P/N 031-300-100-234
REV	ECN	DESCRIPTION	DRAWN CHRIS HERTZLER APPROVED CHRIS HERTZLER D5/26/97
A	990101	CHG SLIP RING WIRING	SCALE: NONE SHEET: 1 OF 1
<small>PAT Equipment Corporation reserves proprietary rights in this drawing. All rights are reserved. No part of this drawing or the equipment described herein may be reproduced without the written consent of PAT Equipment Corporation. This drawing is subject to technical modification without prior notice.</small>		SIZE DWG NO. B70153	C.A.G.E. 79760
		A 031 300 31 0234	REV

16 PIN RECEPTICAL AT BOOM BASE



- NOTES:
- 1 OUTER SHIELD GROUNDED AT STRAIN RELIEF CONNECTOR
 - 2 INNER SHIELD INSULATED AND CONNECTED AS SHOWN
 - 3 OUTER SHIELD INSULATED AND CONNECTED AS SHOWN
 - 4 A = +9V
B = -9V
C = +SIGNAL
D = -SIGNAL
 - 5 SWITCH PREWIRED AND POTTED
OS = OUTER SHIELD
IS = INNER SHIELD

PAT		PAT EQUIPMENT CORPORATION 1665 ORCHARD DRIVE CHAMBERSBURG, PA 17201		GENERAL TOLERANCES X.XX - 0.01 X.XXX - 0.005		MAIN BOOM DIAGRAM WITH 6 CORE LENGTH CABLE REEL	
REV	ECN	DESCRIPTION	CSH	APV	DATE	P/N	DRAWN
A	B70Z49	INCORRECT WIRING IN CABLE REEL FOR LINERIDER	CSH		08/11/87	D31-300-100-366	CHRIS HERTZLER
		INCORRECT WIRING IN CABLE REEL FOR LINERIDER		APPROVED	05/28/87	CHRIS HERTZLER	
		INCORRECT WIRING IN CABLE REEL FOR LINERIDER		SCALE:	NONE	SHEET: 1 OF 1	
		INCORRECT WIRING IN CABLE REEL FOR LINERIDER		SIZE	DWG NO.	REV	
		INCORRECT WIRING IN CABLE REEL FOR LINERIDER		B70153		A 031 300 31 0366 A	
		INCORRECT WIRING IN CABLE REEL FOR LINERIDER		C.A.G.E. 79760			

ANTI-TWO
BLOCK SWITCH

FORCE TRANSDUCER PLUG
HOIST LINE RIDER

CABLE REEL

LENGTH TRANSDUCER

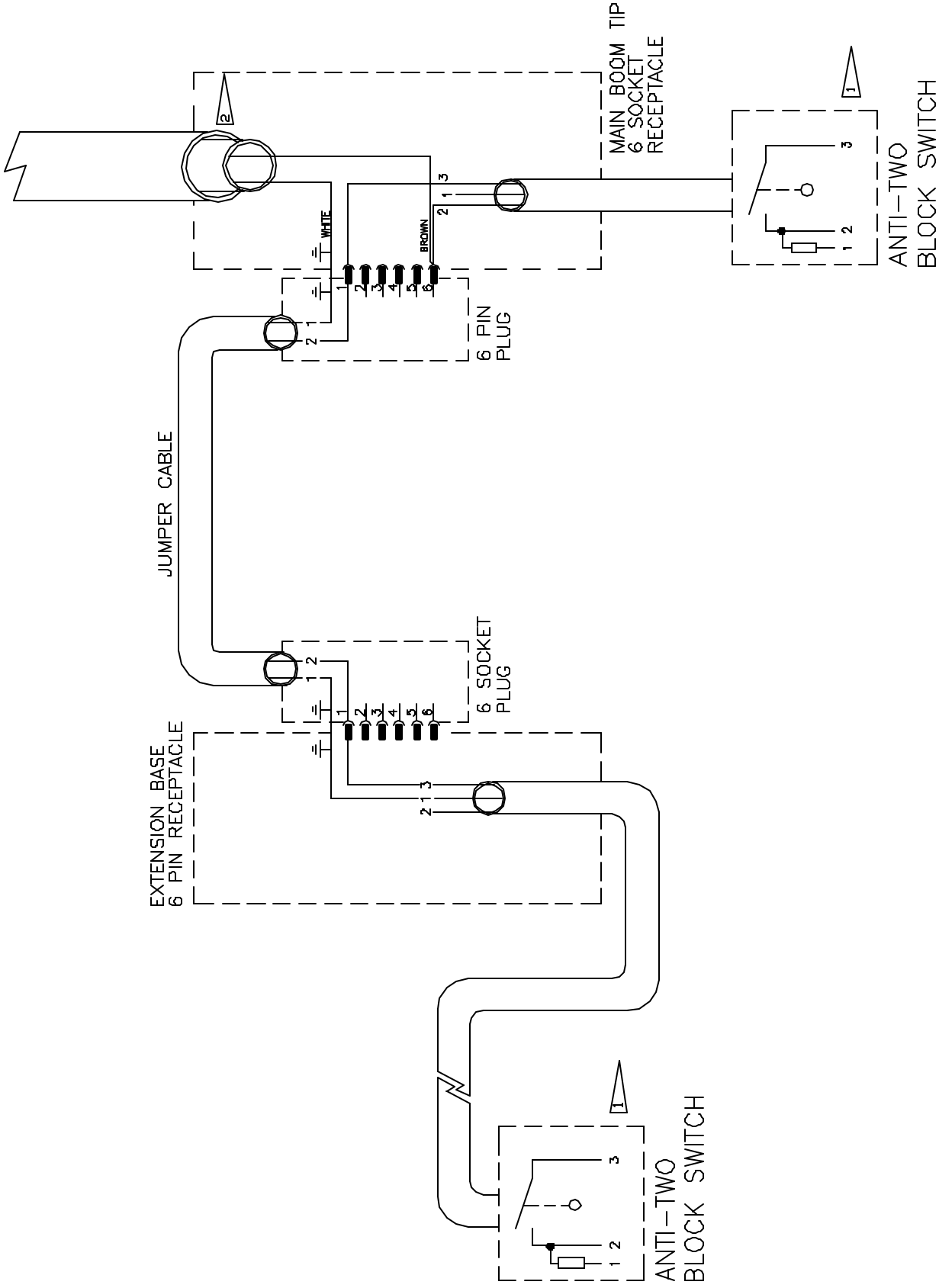
ANGLE TRANSDUCER

- 1 WHITE
- 2 BROWN
- 3 GREEN
- 4 YELLOW
- 5 GRAY
- 6 PINK
- 7 INNER SHIELD

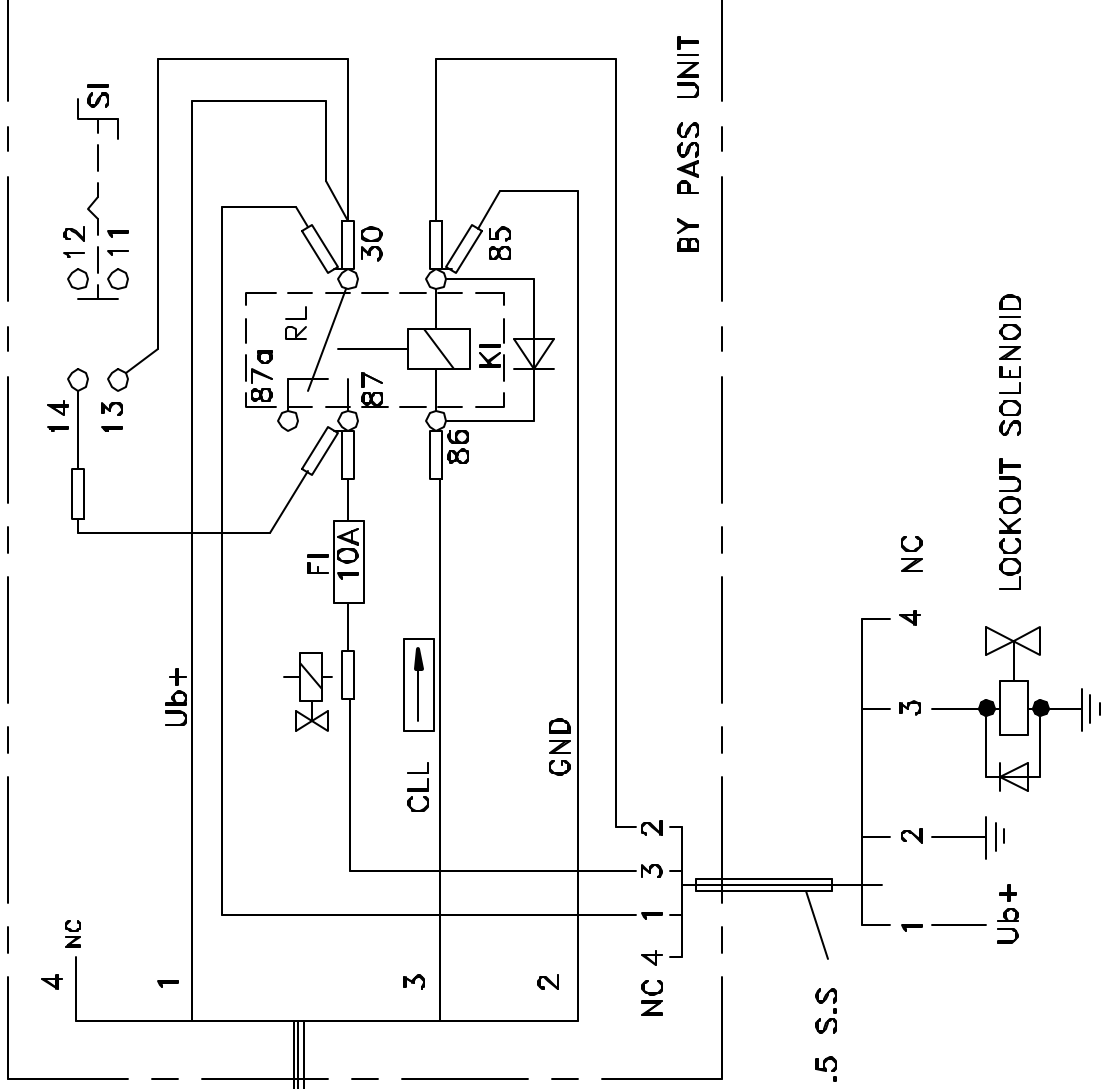
OPTIONAL LINERIDER
CONNECTIONS

- 11 NC
- 12 NC
- 13 NC
- 14 NC
- 15 NC

DUMMY PLUG



PAT EQUIPMENT CORPORATION 1665 ORCHARD DRIVE CHAMBERSBURG, PA 17201		GENERAL TOLERANCES X.XX - 0.01 X.XXX - 0.005		SWING AWAY EXTENSION KIT WIRING DIAGRAM	
REV	ECN	DESCRIPTION	BY	APV	DATE
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C.A.G.E. 79760			SIZE	DWG NO.	REV
			A	031 300 31 0657	—



NOTES:

- +UB = SUPPLY VOLTAGE
- GND = GROUND
- CLL = CENTRAL LEVER LOCKOUT SYSTEM
- RL = RELAY
- SI = BYPASS KEY SWITCH
- FI = FUSE
- NC = NOT CONNECTED

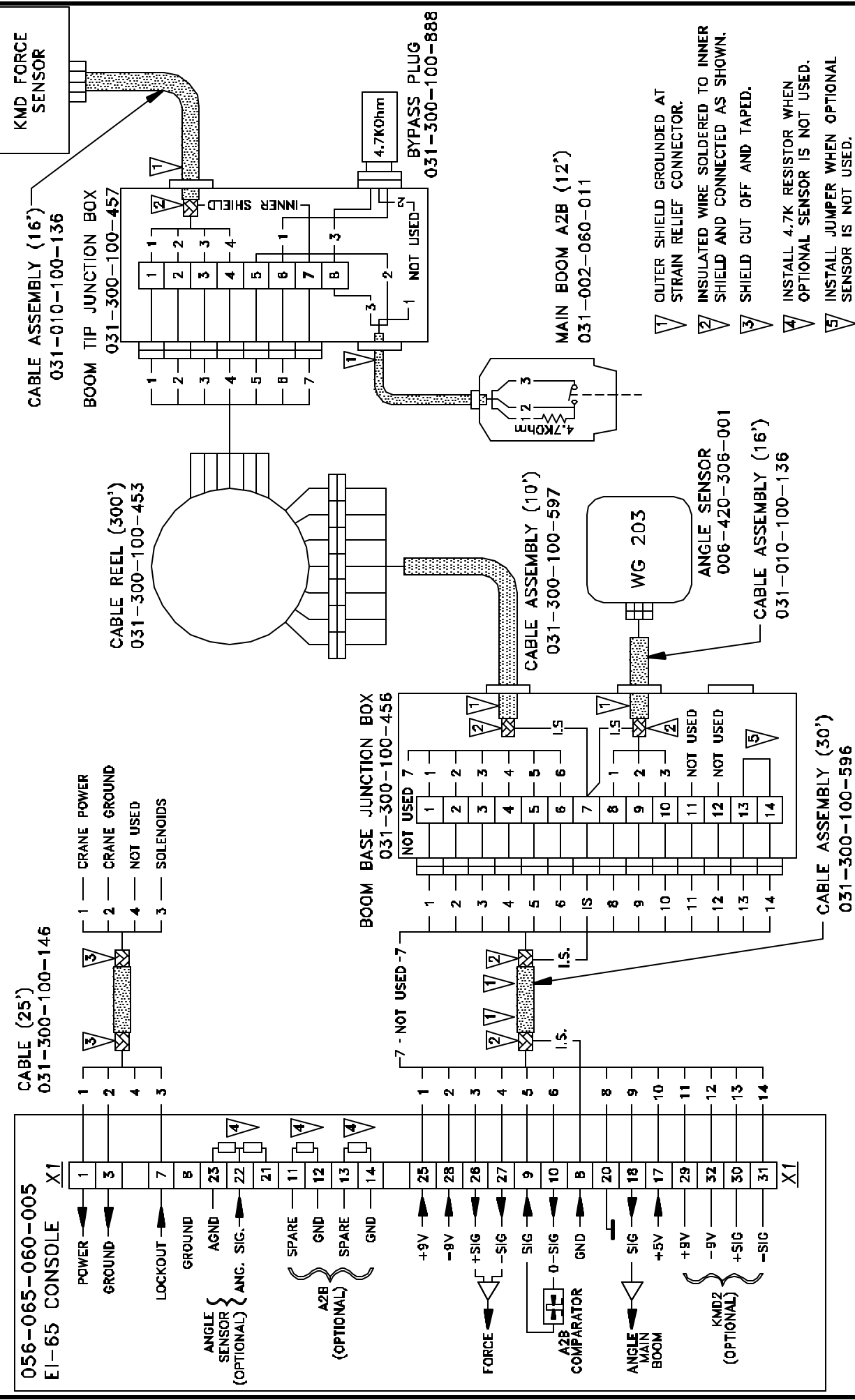
PAT AMERICA, INC.
 1665 ORCHARD DRIVE
 CHAMBERSBURG, PA 17201

KEY SWITCH LOCKOUT BOX ASSEMBLY
WIRING DIAGRAM

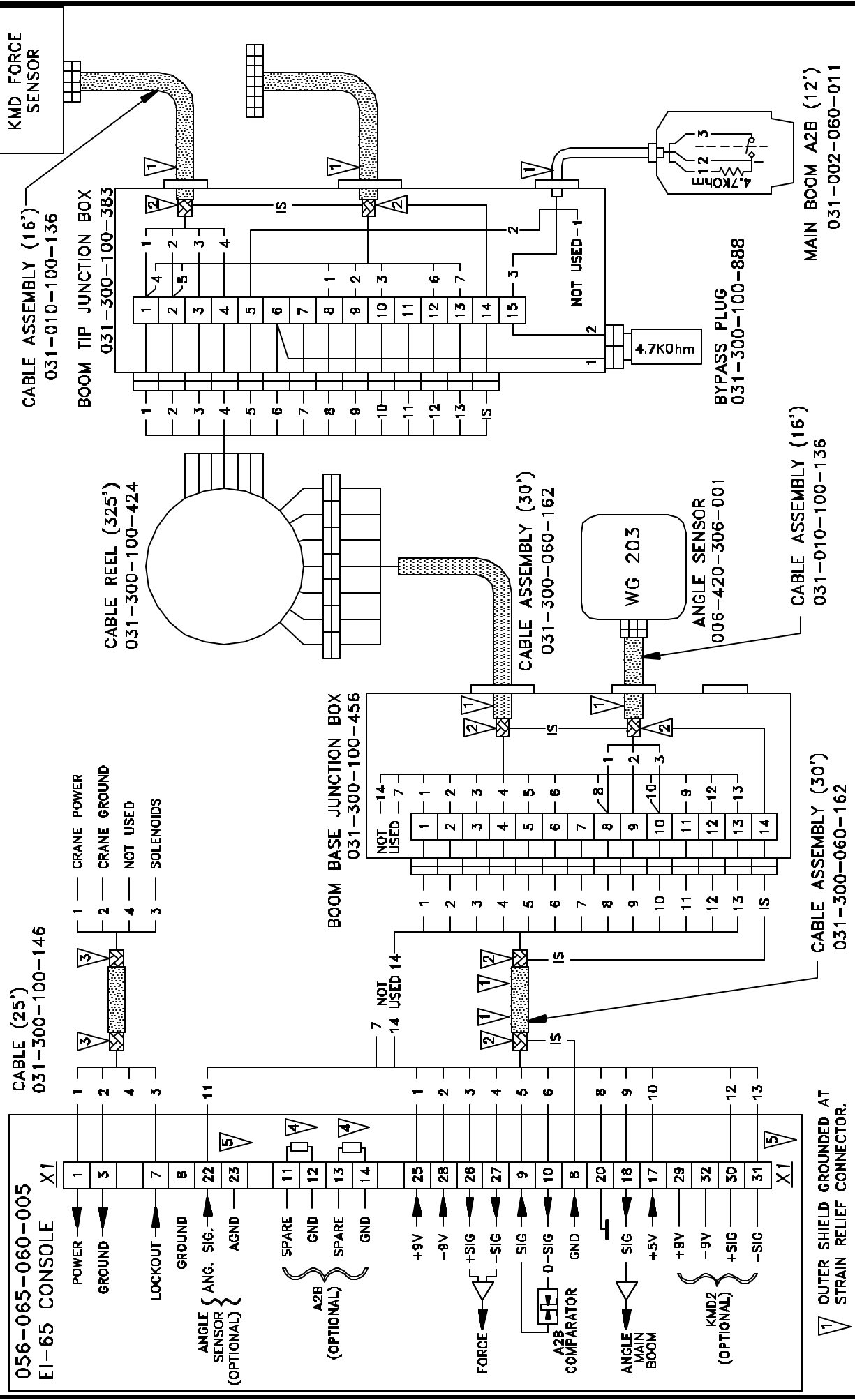
GENERAL TOLERANCES XXXX = 0.005	P/N	031-300-100-197
BY APV	DATE	DRAWN
CSH	08/23/99	APPROVED
CSH	04/15/99	SCALE
CSH	06/19/97	SIZE DWG NO.

REV	ECN	DESCRIPTION
C	940085	ADD NOTES & CHG FUSE TO 10A FROM 1A
B	940053	DEL. TERMINAL STRIP, CHG TITLE BLOCK
A	970195	ADD RELAY, 4X1.5 SS FROM CRANE ELEC TO LOCKOUT

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PAT EQUIPMENT CORPORATION 1665 ORCHARD DRIVE CHAMBERSBURG, PA 17201		GENERAL TOLERANCES X.XX - 0.01 X.XXX - 0.005	EI 65 SYSTEM 7 COND REEL LATTICE BOOM WIRING
REV	ECN	DESCRIPTION	P/N
			031-300-100-983
		BY APV	DRAWN
		DATE	CHRIS HERTZLER
			D5/30/87
			CHRIS HERTZLER
			D5/30/87
		SCALE: NONE	SHEET: 1 OF 1
		SIZE: DWG NO.	
		870174	
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A 031 300 31 0983		REV	



PAT		PAT EQUIPMENT CORPORATION 1665 ORCHARD DRIVE CHAMBERSBURG, PA 17201		GENERAL TOLERANCES X.XX - 0.01 X.XXX - 0.005		EI 65 SYSTEM 14 COND REEL LATTICE BOOM WIRING	
REV	ECN	DESCRIPTION	BY	APV	DATE	DRAWN	P/N
A	B800B5	CHG WIRING FOR INSTALLATION	CSH	CSH	08/31/89	CHRIS HERTZLER	031-300-101-211
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SHEET: 1 OF 1		SIZE: DWG NO.		C.A.G.E. 79760		REV	
A		031 300 31 1211		A		A	

CALIBRATION Table of Contents

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1 GENERAL INFORMATION

The Length-Angle-Radius-Load Indicating System EI 65 must be calibrated after completing installation, crane modification, or anytime there is an indication of inaccuracy. The calibration will match the sensor installed on the industrial crane. Refer to the Installation Manual for the system and sensor installation.

Prior to starting the calibration, it is advised to first read over this procedure in its entirety. This will also allow you a chance to obtain any necessary information. The purpose of this manual is to provide calibration information required before operating the system. Refer to the Operator Manual for system description and console controls.

REFERENCE INFORMATION:

PAT Angle-Length-Radius-Load Indicator System EI 65 Operator's Manual. 56 065 08 0005.

PAT Angle-Length-Radius-Load Indicator System EI 65 Installation Manual. 031-300-190-008.

2 WARNINGS

Always refer to operational instructions and load charts provided by the crane manufacturer for specific crane operation and load limits.

The Length-Angle-Radius-Load Indicating System EI 65 is not and shall not be, a substitute for good operator judgment, experience, or use of acceptable safe operating procedures.

The operator is responsible for operating the crane within the manufacturer's specified parameters.

The crane operator shall ensure that all warnings and instructions provided by the manufacturer are fully understood, observed, and remain with the crane.

Prior to operating the crane, the operator must carefully read and understand the information in the Operator's Manual so that he knows the operation and limitations of the Length-Angle-Radius-Load Indicating System EI 65.

3 ESSENTIAL INFORMATION FOR CALIBRATION:

- 3.1 Prior to powering up the system, verify all wiring. All unused channels must be occupied with dummy signals meeting the following requirements:
- The second angle channel must have a voltage divider installed. Install two 4.7k resistors, one between X1 #21-22 and the other between X1 #22-23.
 - The second and third A2B channels must have a 4.7k resistor. Install a 4.7k resistor between X1 #11-12 and X1 #13-14.
 - The second force channel must have a jumper installed between X1 #30-31.
 - A no load system must have a jumper installed between X1- #26-27, for the first force channel.
- 3.2 Mechanically set the length and angle sensors as follows: (See Appendix A. Mechanical Adjustment for Sensors).
- Length Sensor - With the boom sections fully retracted set the length potentiometer by turning the center screw counter clockwise slowly to a soft stop.
 - Angle Sensors: Align the angle sensors with the boom at zero degrees.
- 3.3 Write down the following geometric measurements, which will be used during calibration. (See Figure 1. Crane Measurements). The measurements taken should be in units that correspond to the load chart. (i.e. lbs/feet, Kg/meters, US-Tons/feet, Metric-ton/meters).

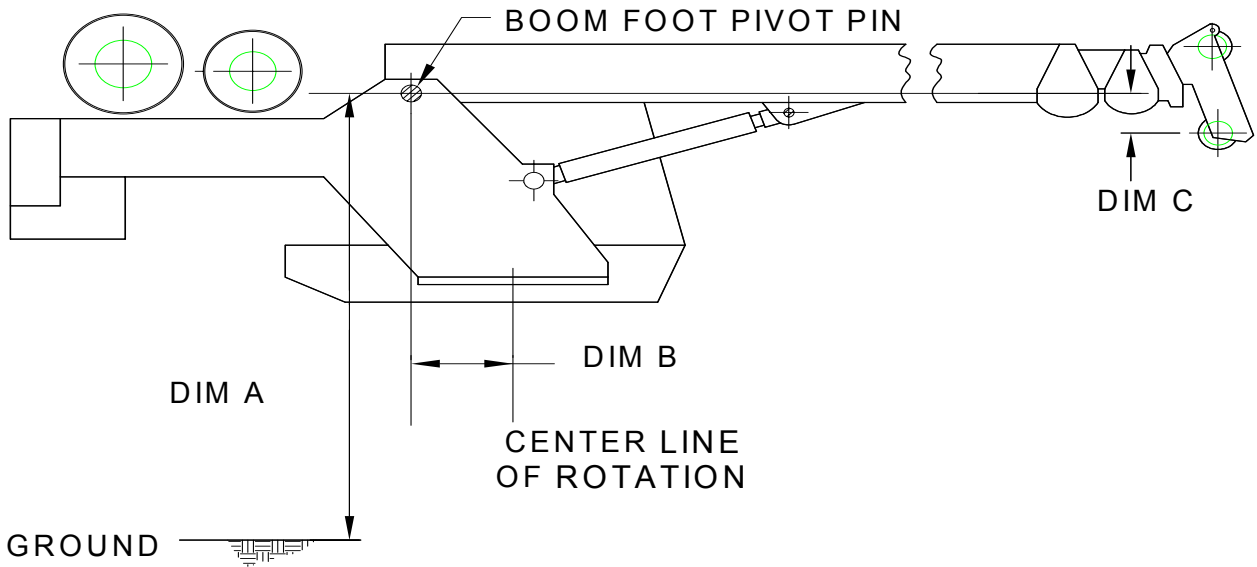


FIGURE 1. CRANE MEASUREMENTS

Dimension A: The vertical distance from the boom foot pivot pin to the ground. (Elevation Offset)

- A. Dimension B: The horizontal distance from the boom foot pivot pin to the centerline of rotation. (Radius Offset)
- B. Dimension C: The head offset, which is the vertical measurement between the boom foot pivot pin to the lower head sheave center pin. (Head Offset)
- C. Jib extension lengths minimum and maximum

Write the dimensions in the Table provided.

Table 1. Measurements

Dimension A (Elevation Offset)	
Dimension B (Radius Offset)	
Dimension C (Head Offset)	
Jib 1 min/max	
Jib 2 min/max	
Jib 2 angle min/max	

- 3.4 Calibration of a linerider will require the hoist rope line pull information, which should be provided by the manufacturer. Use single part line when calibrating the linerider. Lineriders require specific wire rope size. See Table 2 to ensure your rope size matches your linerider that is provided.

NOTE: A new wire rope is normally oversized, and the oversized amount will depend on the diameter of the rope. With normal wear, the inner core breaks down and the diameter decreases. See manufacturer's guidelines for wire rope replacement conditions.

Table 2. Lineriders should match the wire diameter of your hoist rope.

ITEM NUMBER	DESCRIPTION with WIRE ROPE SIZE	WIRE ROPE DIAMETER ADVISED RANGE
048-311-060-001	SENSOR, LINERIDER SKM311 1/4"	±1/32
048-311-060-002	SENSOR, LINERIDER SKM311 1/2"	±1/32
048-311-060-003	SENSOR, LINERIDER SKM311 9/16"	±1/32
048-312-060-002	SENSOR, LINERIDER SKM312 3/4"	±1/32
048-312-060-001	SENSOR, LINERIDER SKM312 5/8"	±1/32
048-312-060-003	SENSOR, LINERIDER SKM312 7/8"	±3/64
048-312-060-004	SENSOR, LINERIDER SKM312 1"	±3/64
048-312-060-005	SENSOR, LINERIDER SKM312 1 1/8"	±3/64
031-300-060-009	SENSOR, LINERIDER SKM312 1-1/4"	±1/16

- 3.5 Calibration of dead end force transducers requires two parts of line.
- 3.6 Always follow the manufacturer's guidelines when operating the crane.
- 3.7 Always work within the capacity of the rated load charts provided by the manufacturer.
- 3.8 The total load includes the load, rigging, cables, and hook block.
- 3.9 Test load should be 75% of maximum rated load for the crane's configuration or condition.

NOTE: To comply with SAE J376 standards, the test load must be to a known accuracy of ±1%.

4 CALIBRATION

- 4.1. Power up the system, the screen will display EI 65/10 software version 1.61 and date 30.10.00.
- 4.2. Within 5 seconds, simultaneously press the “OK” and “SELECT” buttons in order to start calibration. Hold these buttons (approximately 15 seconds) until the screen changes to “CALIB. PASSWORD”. If these buttons are not pressed and held the screen then changes to the existing operating configuration. See Operators Manual 56 065 08 0005 for operating instructions.
- 4.3. Enter the calibration password “0815”. Use the “UP” and “DOWN” buttons to select the number and the “OK” button to confirm each entry.

Enter 0 - OK
8 - OK
1 - OK
5 - OK

NOTE: From this point forward, the sections can be made by pressing “OK” or skipped by pressing arrow “DOWN”.

- 4.4. Select CONFIG DEFAULT by pressing the “OK” button.
- 4.5. CONFIG LANGUAGE - Press “OK” to select and use the arrow “UP and DOWN” buttons to select a language; English, Spanish, or French. When complete press the “OK” button.
- 4.6. CONFIG UNITS - Press “OK” to select and use the arrow “UP and DOWN” buttons to select the load units; LBS (lbs), TONS (t), KILOGRAMS (kg), US-TONS (tons). When complete, press the “OK” button.

NOTE: Select the units used in the load charts provided by the manufacturer.

- 4.7. SET CRANE DIMENSIONS - Calibrates the angle sensor and defines the required geometric measurement of the crane. Press “OK” to select.
 - 4.7.1. SET BOOM ANGLE - Measure the boom angle, using an inclinometer or similar device. Press the arrows “UP or “DOWN” to adjust the displayed angle to match the measured angle. Press “OK” to enter angle.

NOTE: Measurements should be in units that correspond to the load chart. (i.e. lbs/feet, Kg/meters, US-Tons/feet, Metric-ton/meters).

- 4.7.2. ELEV. OFFSET – Elevation Offset is the vertical measurement from the boom foot pivot pin to the ground, as taken in step 3.3.A. Press the arrows “UP and DOWN” to adjust the display. Press “OK” to enter measurement.

- 4.7.3. RADIUS OFFSET - This is the horizontal measurement between the boom foot pivot pin and the centerline of rotation, as taken in Step 3.3.B. If the boom foot pivot pin is located behind the centerline of rotation, the value needs to be entered as a positive. If the Pivot pin is forward of the centerline of Rotation the value needs to be entered as a negative. Press the arrows "UP or "DOWN" to adjust the display. Press "OK" to enter measurement.
- 4.7.4. HEAD OFFSET - The vertical measurement between the boom foot pivot pin and the lower head sheave center pin, as taken in Step 3.3.C. If the center pin is below the boom foot pivot pin, enter the value as a negative by using the arrows "UP or DOWN" to adjust the display. Press "OK" to enter measurement.
- 4.8. SET BOOM TYPE - This section configures the type of main boom, FIXED or TELE. Press the "OK" button and proceed by answering the questions on the screen.
- 4.8.1. MAIN BOOM FIXED? - Press "OK" to accept or the arrow "DOWN" for next selection.
- 4.8.1.1. Enter the minimum length using the arrows "UP or DOWN" to adjust the display. Press "OK" to enter length.
- 4.8.1.2. Enter the maximum length using the arrows "UP or DOWN" to adjust the display. Press "OK" to enter length.
- 4.8.2. MAIN BOOM TELE? - Press "OK" to accept or the arrow "DOWN" for next selection.

WARNING: The operator is responsible for operating the crane within the manufacturer's specified parameters.

- 4.8.2.1. MAIN BOOM MIN? - DRIVE MAIN BOOM ON MIN POSITION! - Fully retract the main boom. Ensure that the length potentiometer has been reset by turning the center screw counter clockwise until you have reached a soft stop. Refer to Section 3.2.
- 4.8.2.2. Press "OK" to display minimum length preset value.
- 4.8.2.3. Press the arrows "UP or "DOWN" to adjust the displayed length to minimum or fully retracted length.
- 4.8.2.4. Press "OK" to enter length minimum preset value.
- 4.8.2.5. MAIN BOOM MAX? - DRIVE MAIN BOOM ON MAX POSITION! Fully extend the main boom; include the power pin fly extension when applicable.
- 4.8.2.6. Press "OK" to display maximum preset value.
- 4.8.2.7. Press the arrows "UP or "DOWN" to adjust the displayed length to maximum or fully extended length.
- 4.8.2.8. Press "OK" to enter length.

4.9. CONFIG EXTENSION - This section configures two extensions with minimum and maximum length, a minimum and maximum angle (OFFSET MIN/MAX) for the second extension (LENGTH 2), and whip extension or variable angled extension with angle sensor. Use Figures 2 through 5 to help identify your configuration. Press "OK" and proceed by entering extension lengths, angle, and calibrating whip extension angle. Configure the extensions that your crane will use and enter zero for unused portions of CONFIG EXTENSION. Recommendation: Set up the extension's minimum length as zero, so if this extension is removed you can change the length in the SELECT section of operation instead of entering calibration mode to remove extension.

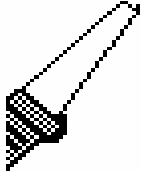


Figure 2. Fixed Extension
(Enter extension as Length 1 minimum and maximum)

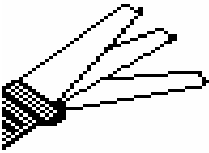


Figure 3. Fixed, Offsettable Extension
(Enter extension as Length 2 minimum and maximum and angle offset minimum and maximum)

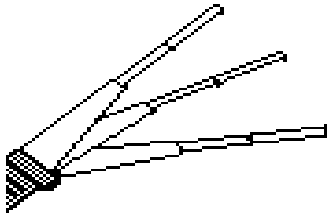


Figure 4. Tele-Offsettable Extension
(Enter extension as Length 2 minimum and maximum and angle offset minimum and maximum)

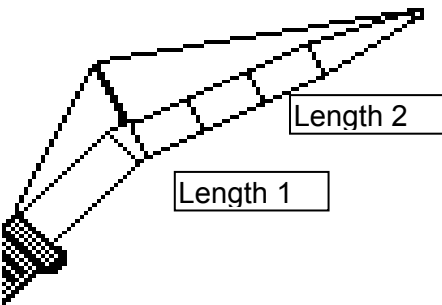


Figure 5. Fixed Extension with Offsettable Jib
(Enter base extension as Length 1 minimum and maximum. Enter luffing extension as Length 2 minimum and maximum and set whip extension angle sensor.)

- 4.9.1. LENGTH_1 MIN - Press the arrows “UP or “DOWN” to display minimum length. Press “OK” to enter length.
- 4.9.2. LENGTH_1 MAX - Press the arrows “UP or “DOWN” to display maximum length. Press “OK” to enter length.
- 4.9.3. LENGTH_2 MIN - Press the arrows “UP or “DOWN” to display minimum length. Press “OK” to enter length.
- 4.9.4. LENGTH_2 MAX - Press the arrows “UP or “DOWN” to display maximum length. Press “OK” to enter length.
- 4.9.5. OFFSET MIN - Press the arrows “UP or “DOWN” to display minimum offset angle. Press “OK” to enter angle.
- 4.9.6. OFFSET MAX - Press the arrows “UP or “DOWN” to display maximum offset angle. Press “OK” to enter length.
- 4.9.7. WHIP EXTENSION - This is a variable angled extension (luffing) with angle sensor. Press the arrows “UP or “DOWN” to select yes or no and Press “OK” to confirm entry. If no go to Step 9.
- 4.9.7.1. WG_OFFSET EXT. - Align the offsetable jib with the extension and/or main boom so that the angles are equal. Measure the extension angle using an inclinometer or similar device. Press the arrows “UP or “DOWN” to adjust the displayed angle to match the measured angle. Press “OK” to enter angle.

NOTE WHEN SETTING THE FORCE – There are 2 possible sets of minimum and maximum load data when calibrating the force sensors.

- The first set of load data is used to calibrate the force sensor at single or minimum parts of line and must be completed.
- The second set of data is use to calibrate the force sensor with many or maximum parts of line. The second set of data is not required. If data is not entered, the system will use a friction factor that is defined in the software.

4.10. SET FORCE 1 FIRST SET - This is the first set of data for the main boom force sensor.

4.10.1. Press “OK” to calibrate the KMD1 - Main linerider/load cell or press the arrow “DOWN” button to continue.

4.10.2. PARTS OF LINE - Use the arrows “UP or DOWN” to select parts of line.
NOTE: For the 1st set of data the parts of line should be a small figure. Recommended is ‘1’. Two parts of line are needed for a load cell and one part of line for a Linerider.

- 4.10.3. FORCE 1 ZERO – With no load on the hook block, use the arrows “UP or DOWN” to enter the value for the minimum force on the main boom. NOTE: The total load includes the rigging, cables, and hook block.
- 4.10.4. Press “OK” to confirm Load.
- 4.10.5. FORCE 1 LOAD - Lift a test load of at least 75% of permissible line pull for the crane configuration. See crane manufacturer’s data for approximate load. NOTE: To comply with SAE J376 standards, the test load must be to a known accuracy of $\pm 1\%$.
- 4.10.6. Use the arrows “UP or DOWN” to adjust the display load to indicate your total test load. NOTE: The total load includes the load, rigging, cables, and hook block.
- 4.10.7. Press “OK” to confirm total load.
- 4.11. SET FORCE 1 2nd SET - This is the second set of data for the main boom force sensor. NOTE: The first set of data must be used before entering the second set of data. NOTE: For the second set of data, the parts of line should be increased. The maximum number of possible parts of line is recommended.
- 4.11.1. Press “OK” to calibrate the KMD1 - Main linerider/load cell or press the arrow “DOWN” button to continue.
- 4.12. PARTS OF LINE - Use the arrows “UP or DOWN” to select parts of line. NOTE: For the second set of data the parts of line should be a large figure. The maximum number of possible parts of line is recommended.
- 4.12.1. FORCE 1 ZERO – With no load on the hook block, use the arrows “UP or DOWN” to enter the value for the minimum force on the main boom. NOTE: The total load includes the rigging, cables, and hook block.
- 4.12.2. Press “OK” to confirm Load.
- 4.12.3. FORCE 1 LOAD - Lift a test load that is different than the first set of data. See crane manufactures data for approximate load. NOTE: To comply with SAE J376 standards, the test load must be to a known accuracy of $\pm 1\%$.
- 4.12.4. Use the arrows “UP or DOWN” to adjust the display load to indicate your total test load. NOTE: The total load includes the load, rigging, cables, and hook block.
- 4.12.5. Press “OK” to confirm total load.
- 4.13. SET FORCE 2 FIRST SET - This is the first set of data for the auxiliary force sensor KMD2.
- 4.13.1. Press “OK” to calibrate the KMD2 – auxiliary linerider/load cell or press the arrow “DOWN” button to continue.

- 4.13.2. PARTS OF LINE - Use the arrows "UP or DOWN" to select parts of line.
NOTE: For the 1st set of data the parts of line should be a small figure. Recommended is '1'. Two parts of line are needed for a load cell and one part of line for a linerider.
- 4.13.3. FORCE 2 ZERO – With no load on the hook block, use the arrows "UP or DOWN" to enter the value for the minimum force on the main boom.
NOTE: The total load includes the rigging, cables, and hook block.
- 4.13.4. Press "OK" to confirm Load.
- 4.13.5. FORCE 2 LOAD - Lift a test load of at least 75% of permissible line pull for the crane's configuration. See crane manufacturer's data for approximate load. NOTE: To comply with SAE J376 standards, the test load must be to a known accuracy of $\pm 1\%$.
- 4.13.6. Use the arrows "UP or DOWN" to adjust the display load to indicate your total test load. NOTE: The total load includes the load, rigging, cables, and hook block.
- 4.13.7. Press "OK" to confirm total load.
- 4.14. SET FORCE 2 SECOND SET - This is the second set of data for the auxiliary force sensor. NOTE: The first set of data must be used before entering the second set of data. NOTE: For the second set of data the parts of line should be increased. The maximum number of possible parts of line is recommended.
- 4.15. Press "OK" to calibrate the KMD2 - Auxiliary linerider/load cell or press the arrow "DOWN" button to continue.
- 4.15.1. PARTS OF LINE - Use the arrows "UP or DOWN" to select parts of line.
NOTE: For the second set of data the parts of line should be a large figure. Recommended is the maximum number of possible parts of line.
- 4.15.2. FORCE 2 ZERO – With no load on the hook block, use the arrows "UP or DOWN" to enter the value for the minimum force on the main boom.
NOTE: The total load includes the rigging, cables, and hook block.
- 4.15.3. Press "OK" to confirm Load.
- 4.15.4. FORCE 2 LOAD - Lift a test load different from the first set of data. See crane manufactures data for approximate load. NOTE: To comply with SAE J376 standards, the test load must be to a known accuracy of $\pm 1\%$.
- 4.15.5. Use the arrows "UP or DOWN" to adjust the display load to indicate your total test load. NOTE: The total load includes the load, rigging, cables, and hook block.
- 4.15.6. Press "OK" to confirm total load.

- 4.16. CONFIG DISPLAY - This section configures the data that will be displayed on the screen.
- 4.16.1. SHOW LOAD? - YES arrow "UP", NO arrow "DOWN". Press "OK" to confirm.
 - 4.16.2. SHOW TIP HEIGHT? - YES arrow "UP", NO arrow "DOWN". Press "OK" to confirm.
 - 4.16.3. SHOW HOIST? - YES arrow "UP", NO arrow "DOWN". Press "OK" to confirm.
 - 4.16.4. SHOW LENGTH? - YES ARROW "UP", NO arrow" DOWN". Press "OK" to confirm.
 - 4.16.5. SHOW ANGLE? - YES arrow "UP", NO arrow "DOWN". Press "OK" to confirm.
 - 4.16.6. SHOW RADIUS? - YES arrow "UP", NO arrow "DOWN". Press "OK" to confirm.
 - 4.16.7. SHOW JIB ANGLE? - YES arrow "UP", NO arrow "DOWN". Press "OK" to confirm.
 - 4.16.8. SHOW REEVING? - YES arrow "UP", NO arrow "DOWN". Press "OK" to confirm.
- 4.17. ANALOG VALUES – This selection displays the sensor output voltages in millivolts. Can be used to help troubleshoot sensors.
- 4.18. CONFIGURATION READY??? - At this point, you may return to any part of the calibration sections by using the arrows "UP" or "DOWN" to change calibration data. Press "OK" to confirm.
- 4.19. SAVE TO E-EPROM??? - Save calibration data to E-EPROM by pressing "OK". Pressing the arrow "DOWN" for NO will disregard data entries made during this calibration session. If the calibration data is disregarded and the system has not been calibrated as stated in this document, the crane must not be operated. The screen then changes to the current operating configuration. Press "OK" button to proceed to the working screen. Refer to the Operator's Manual, Section 4.2. to set operating conditions
- 4.20. TURN POWER OFF – Turn power off and back on to reset the system with the previously defined calibration.

5 OPERATIONAL CHECKS

After completing calibration, do the following operational checks to verify displayed values. These operational checks should be performed any time there is an indication of inaccuracy.

NOTE: We recommend completing all operational checks before correcting calibration data.

5.1 Check the angle of the main boom and compare it with the measure value. It should be $\pm 1^\circ$. If the angle is incorrect, complete Sections 4.1, 4.2, 4.3 and 4.6.

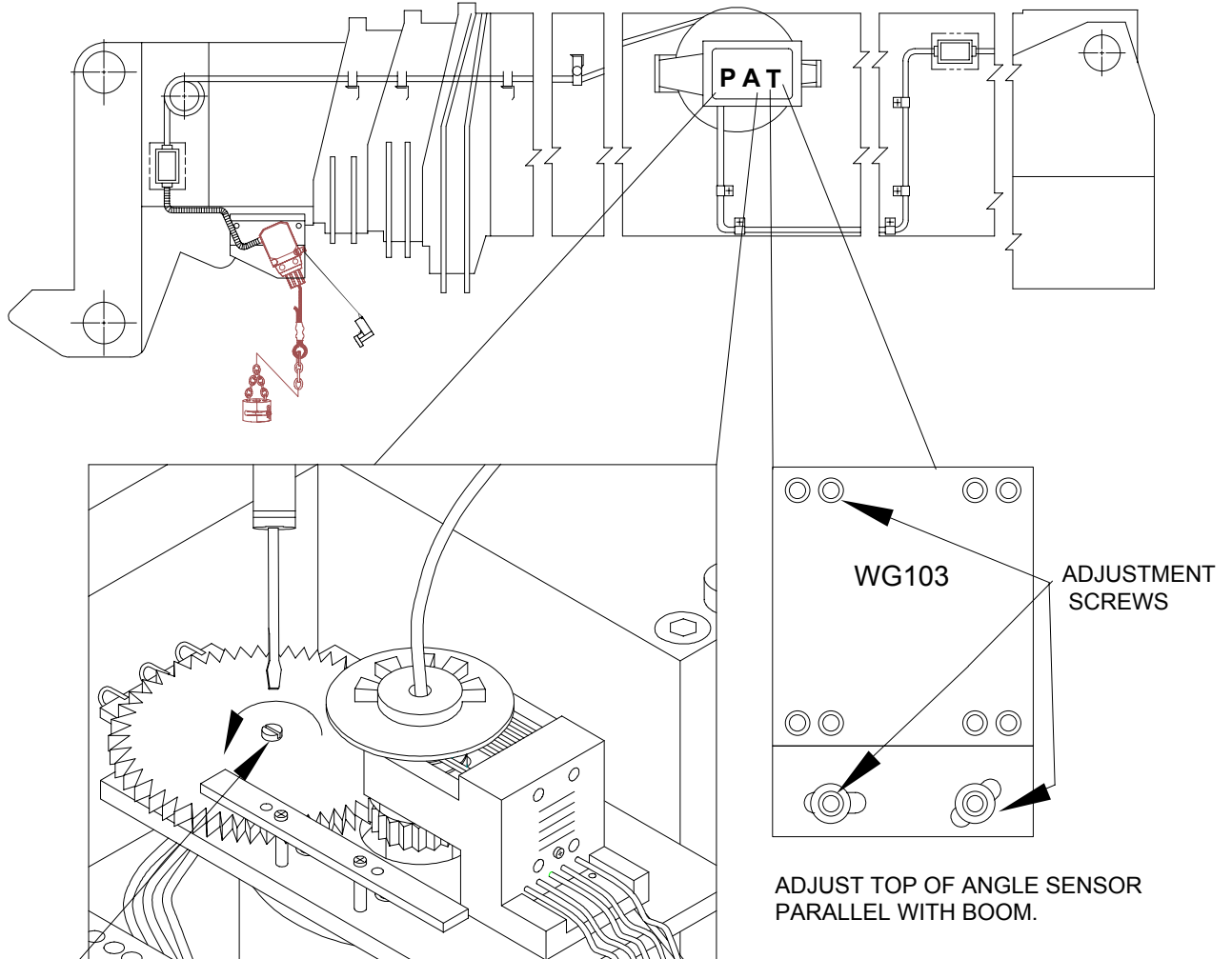
NOTE: Use the select button to specify crane configuration before performing the following checks. See Operators Manual 056 065 08 0005.

5.2. Check the radius displayed and compare it with the measured radius. The radius is a horizontal measurement from the centerline of rotation to the center of the hook block. The displayed radius should be equal to or greater than the measured radius by 10%. For example, if the measured radius equals 15ft then the displayed radius should be 15ft to 16.5ft. If displayed value is incorrect, verify the Rad Offset measurement taken in Section 3.3.B and complete Sections 4.1, 4.2, 4.3, and 4.6.

5.3. Check the total load displayed by picking the known test load. This will require picking a load for each force sensor, KMD1 and KMD2, if applicable. The displayed load should be equal to or greater than the known load by 10%. For example, if the known load equals 12,000lbs then the displayed load should be 12,000lbs to 13,200lbs. If displayed value is incorrect, complete Sections 4.1, 4.2, 4.3, and 4.9 for KMD1 and/or 4.10 for KMD2.

NOTE: To comply with SAE J376 standards, the test load must be to a known accuracy of $\pm 1\%$.

APPENDIX A - MECHANICAL ADJUSTMENT OF SENSORS

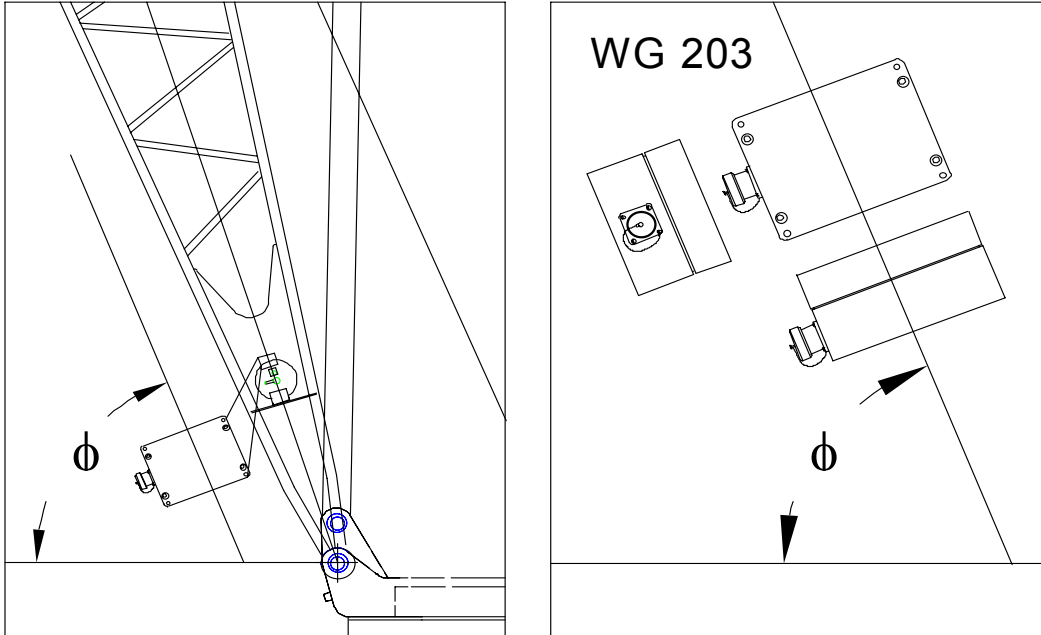


ADJUST LENGTH POTENTIOMETER, WITH BOOM FULLY RETRACTED
TURN THE CENTER SCREW COUNTER CLOCKWISE TO A SOFT STOP.

ADJUST TOP OF ANGLE SENSOR
PARALLEL WITH BOOM.

LATTICE CRANE ANGLE SENSOR ADJUSTMENT

The angle ϕ shown in Figure 1 needs to be within $+0, -0.4$ of the actual angle of the boom. Check boom angle at base/heel section only. After adjustment, compare the actual boom angle with the displayed angle at about 0° , 30° and 60° . To comply with the SAE J375 standards the displayed angle must be $+0.0^\circ$ to -2.0° of the actual angle.



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1 GENERAL INFORMATION

The purpose of this service manual is to provide additional information to assist a service or maintenance person in identifying malfunctions or system problems with the PAT System. A digital voltmeter and regular maintenance and service tools will be required to troubleshoot the system. Note: Knowledge of how to use a digital voltmeter is assumed.

REFERENCE:

Operator's Manual 056-065-190-005
 Calibration Manual 031-300-190-009
 Installation Manual 031-300-190-008

SYSTEM MALFUNCTION:

MB 115.0	J1 85.0	■
J2 50.0	OJ 15.0	E71

In case of a malfunction of the system, an error code which identifies the system malfunction will be displayed in the reeving portion of the display. The error codes are listed in Section 4, Error Codes. The table identifies

various faults that can occur with the EI65, explain each fault, and describe the action, which shall be taken to correct the fault.

Faults within the electronic microprocessor shall be repaired by factory trained service personnel. When these faults occur, contact your authorized dealer or service organization.

If the operator identifies a possible problem in the system, perform the pre-operation inspection Section 5 in the Operator's Manual 056-065-190-005 to define the problem.

SYSTEM DESCRIPTION:

The PAT Length-Angle-Radius-Load Indicator System EI65 has been designed to provide the crane operator with the essential information required to enable the machine to be used within its design parameters. The EI65 System indicates the length and angle of the boom, tip height, working radius and the total weight being lifted by the crane. Using the various sensors and the limits set by the operator, the EI65 System warns the crane operator of certain approaching hazardous conditions which could occur during the operation of his crane.

WARNING

Always refer to operational instructions and load charts provided by the crane manufacturer for specific crane operation and load limits.

2 WARNINGS

- The EI65 is an operational aid, which warns a crane operator of certain approaching hazardous conditions, which could cause damage to equipment and personnel.
- The device is not, and shall not be, a substitute for good operator judgment, experience and use of accepted safe crane operating procedures.
- The responsibility for the safe operation of the crane shall remain with the crane operator who shall ensure that all warnings and instructions supplied are fully understood and observed.
- Prior to operating the crane, the operator must carefully and thoroughly read and understand the information in the operator's manual to ensure that he/she knows the operation and limitations of the indicating system and crane.

3 TROUBLESHOOTING USING THE ANALOG VALUES SCREEN

For a sensor error or problem with a sensor, look at the output voltage of the linerider and angle sensors and compare the reading with the following:

Angle sensor 1.875 at 0°, 2.5 at 45°, or 3.125 at 90°

Linerider under no load is 0 to 15mV not to exceed 2500 mV.

To access the analog output screen use the following procedure.

1. Power up the system. The screen will display EI 65/10 software version and date.
2. To start calibration, within 5 seconds of powering up, simultaneously press the "OK" and "SELECT" buttons. Hold these buttons (approximately 15 seconds) until the screen changes to "CALIB. PASSWORD". *If these buttons are not pressed and held, the screen changes to the existing operating configuration.* Refer to Operator's section in this manual.
3. Enter the calibration password "0815". Use the "UP" and "DOWN" buttons to select the number and the "OK" button to confirm each entry. Enter 0 – OK, 8 – OK, 1 – OK, 5 - OK
4. Scrole to the ANALOG VALUES screen by pressing the "UP" or "DOWN" arrows, pressing "OK" to select and show the following screen.

All Analog input voltages (shown in millivolts), received from the sensors will be displayed here as described below. The minimum values are show in the screen pictured.

The screenshot shows a grid of sensor data. The top row contains '1950', '15', and 'VOLT *1000'. The bottom row contains '0', '3125', and '3125'. Callouts point to these values with descriptive text and icons.

FORCE 1 and FORCE 2
 With no signal or weight applied this should read 15 mv or below. At maximum load the reading should not exceed 2500 mv (+/-25mv).

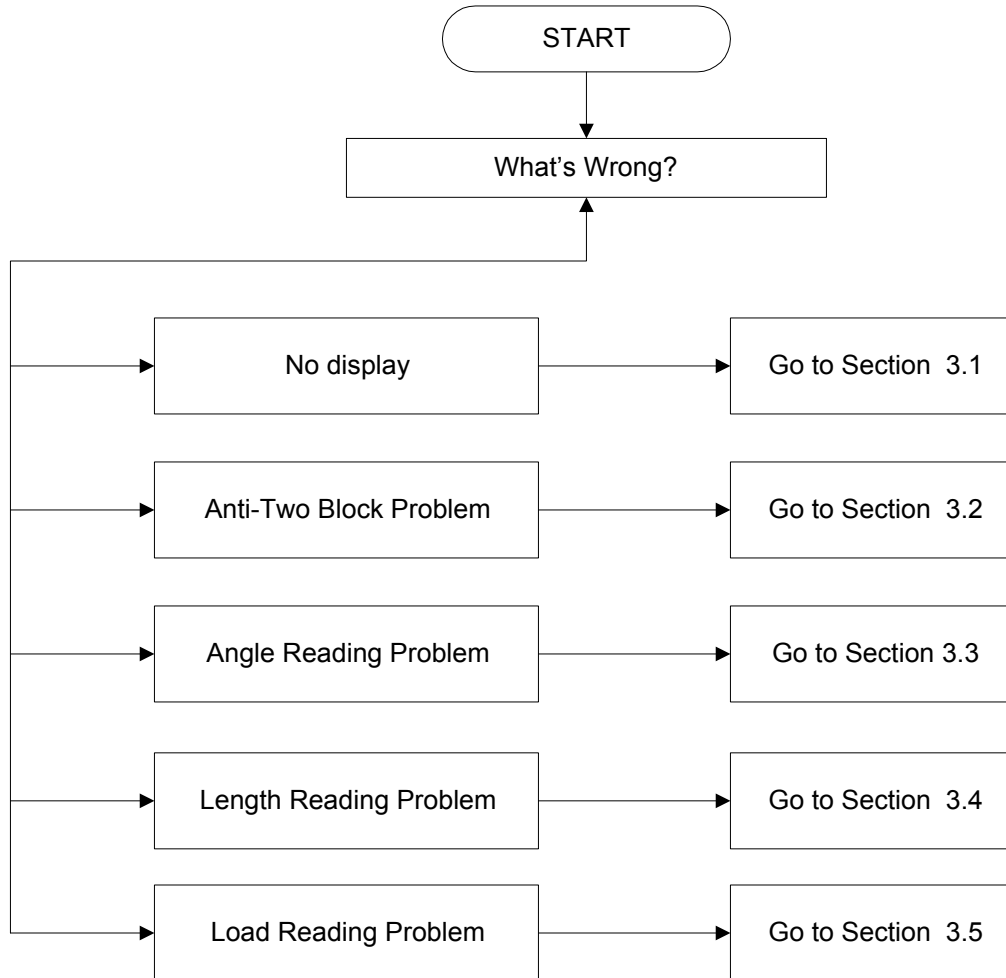
LENGTH (Hydraulic Machines Only)
 reading should be 0 with no sensor installed.

ANGLE 1 and ANGLE 2
 With the boom at zero degrees this should read 3125 mv . At maximum or 90 degrees the reading should be 1875 mv (+/-25mv).

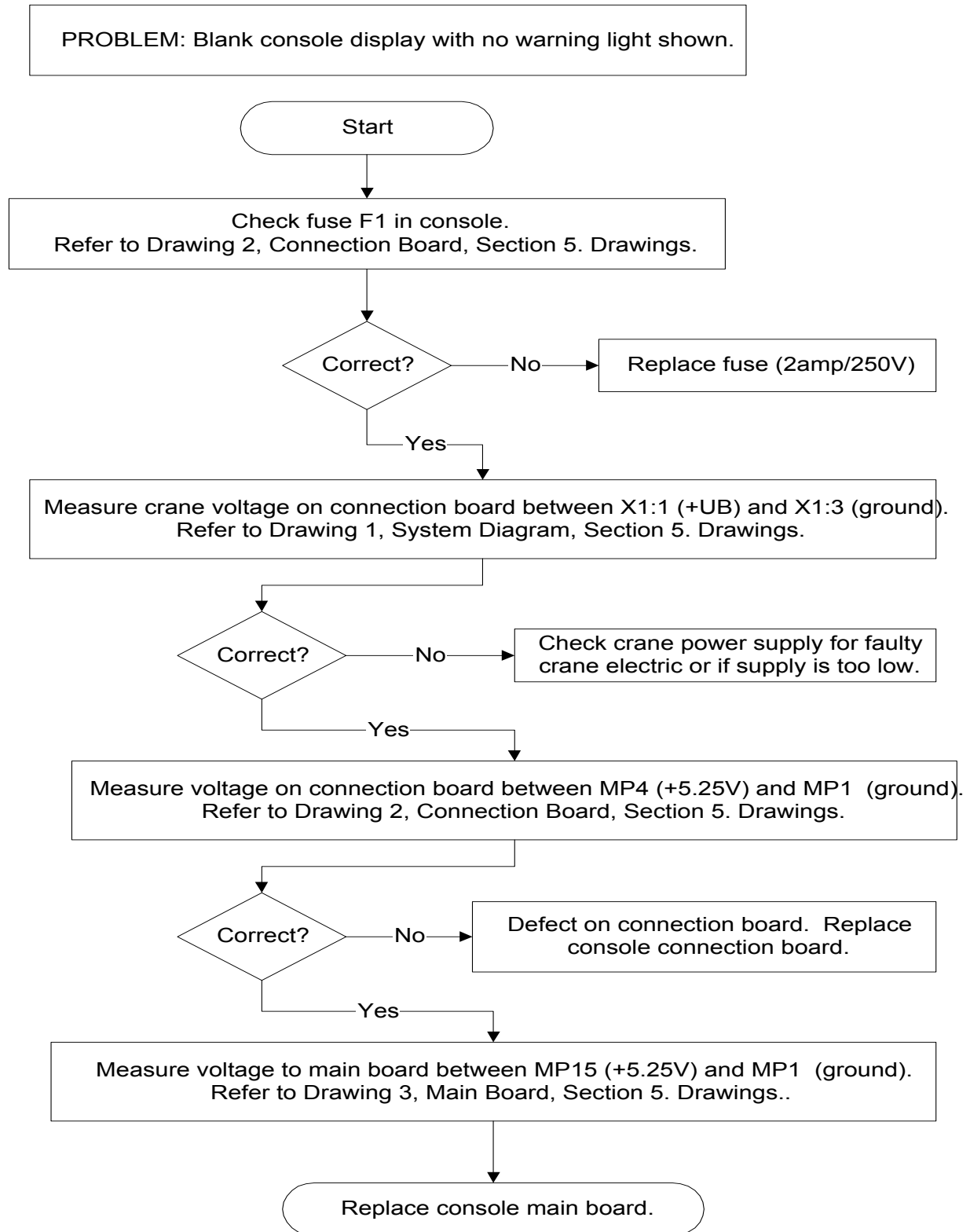
4 TROUBLESHOOTING FLOW CHARTS

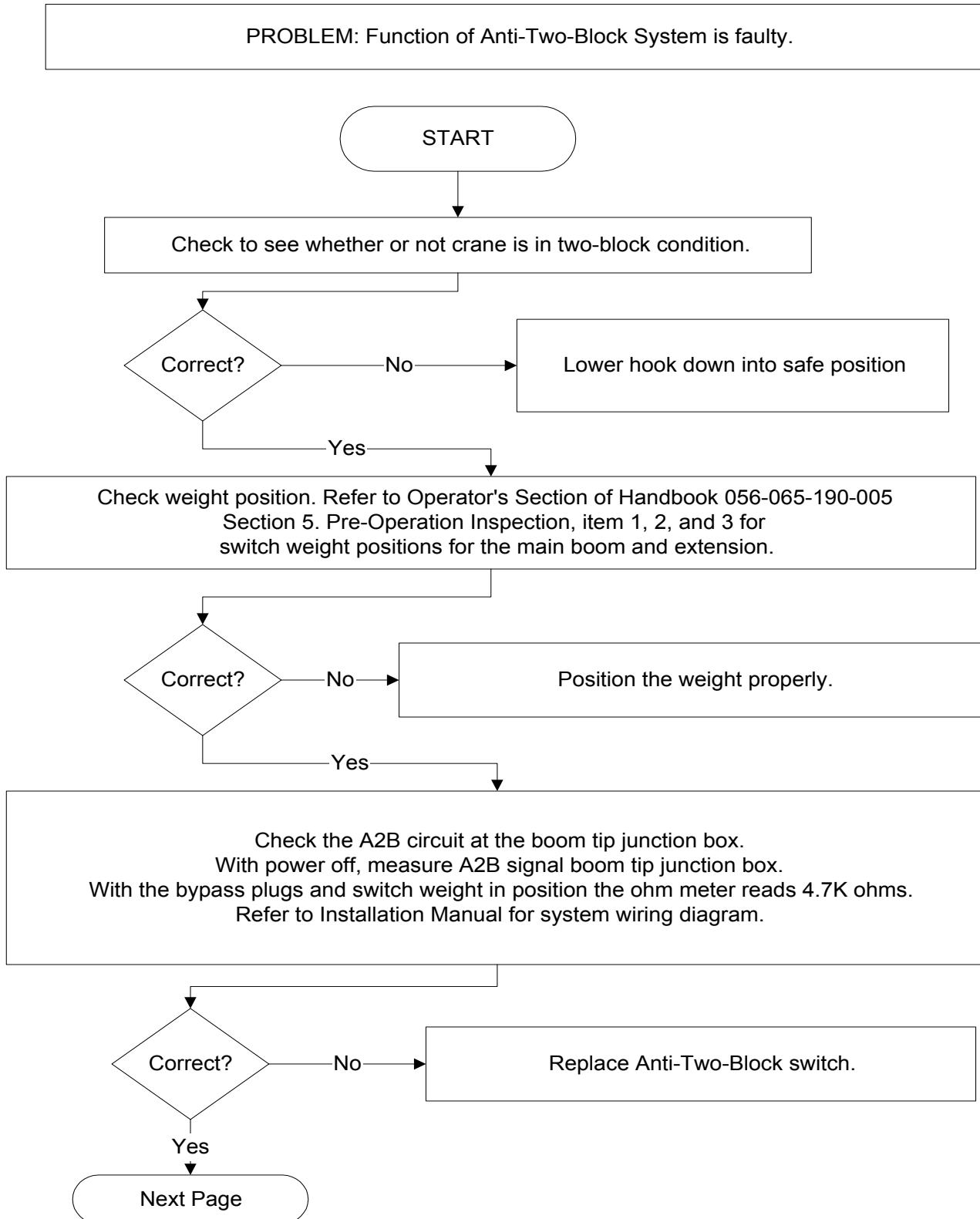
This section explains how to handle a problem that may arise with the EI65, PAT Load Indicator System. The procedures are easy to follow and are given in flowcharts on the following pages. Start with the general flowchart below that will guide you to one of the detailed flowcharts shown in this section. Section 5 contains the necessary drawings needed for troubleshooting.

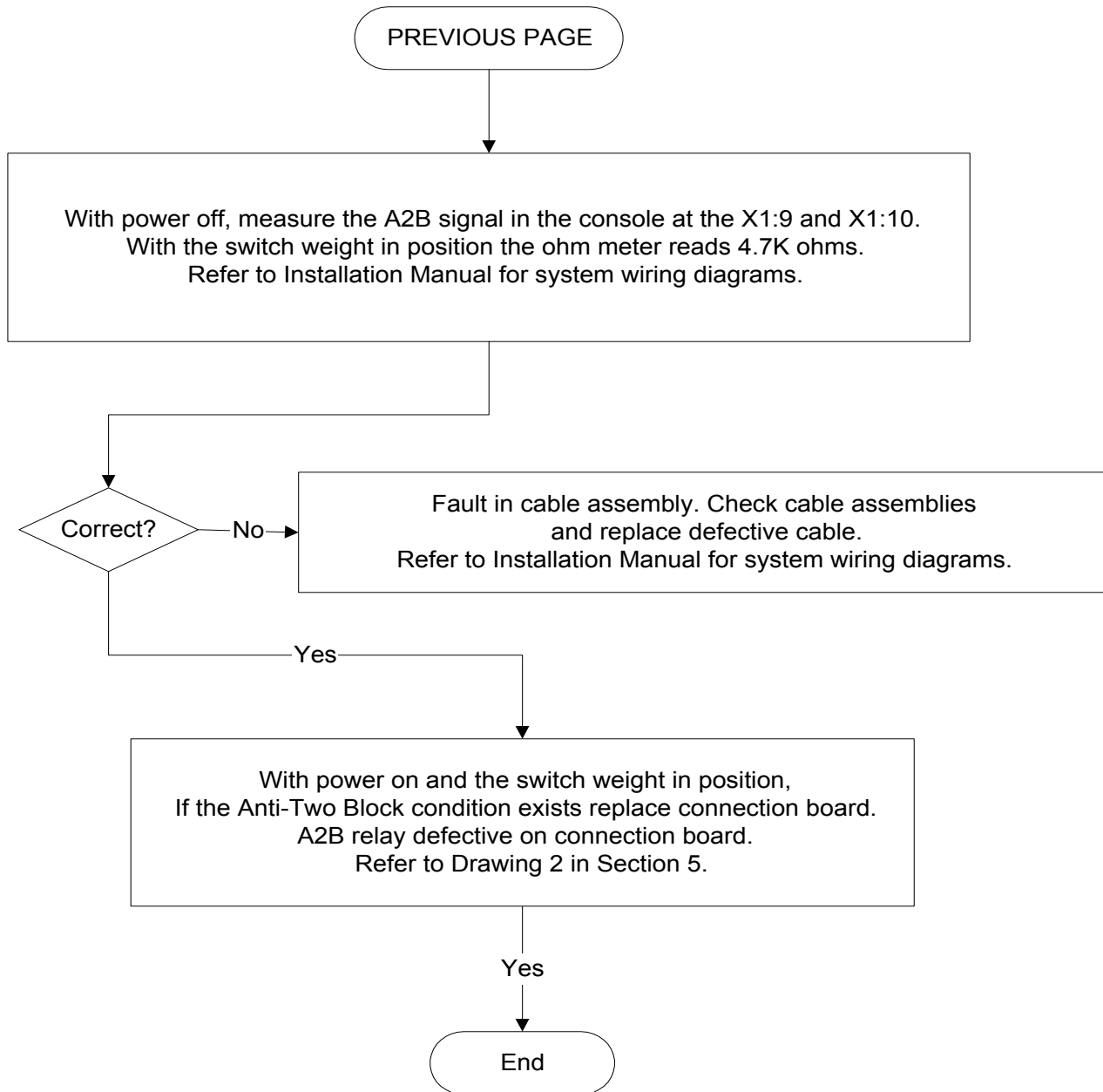
4.1 GENERAL FLOW CHART



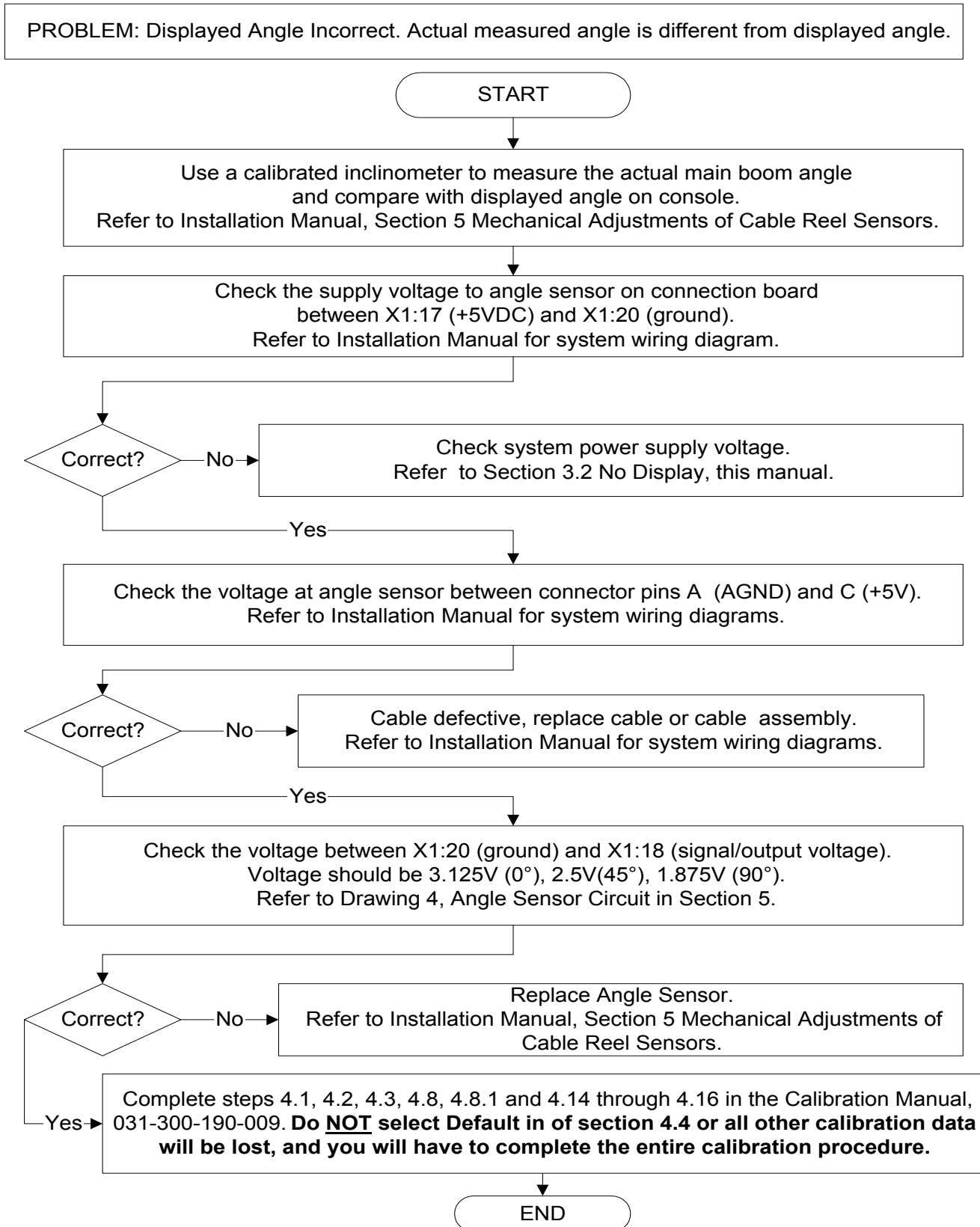
4.2 NO DISPLAY



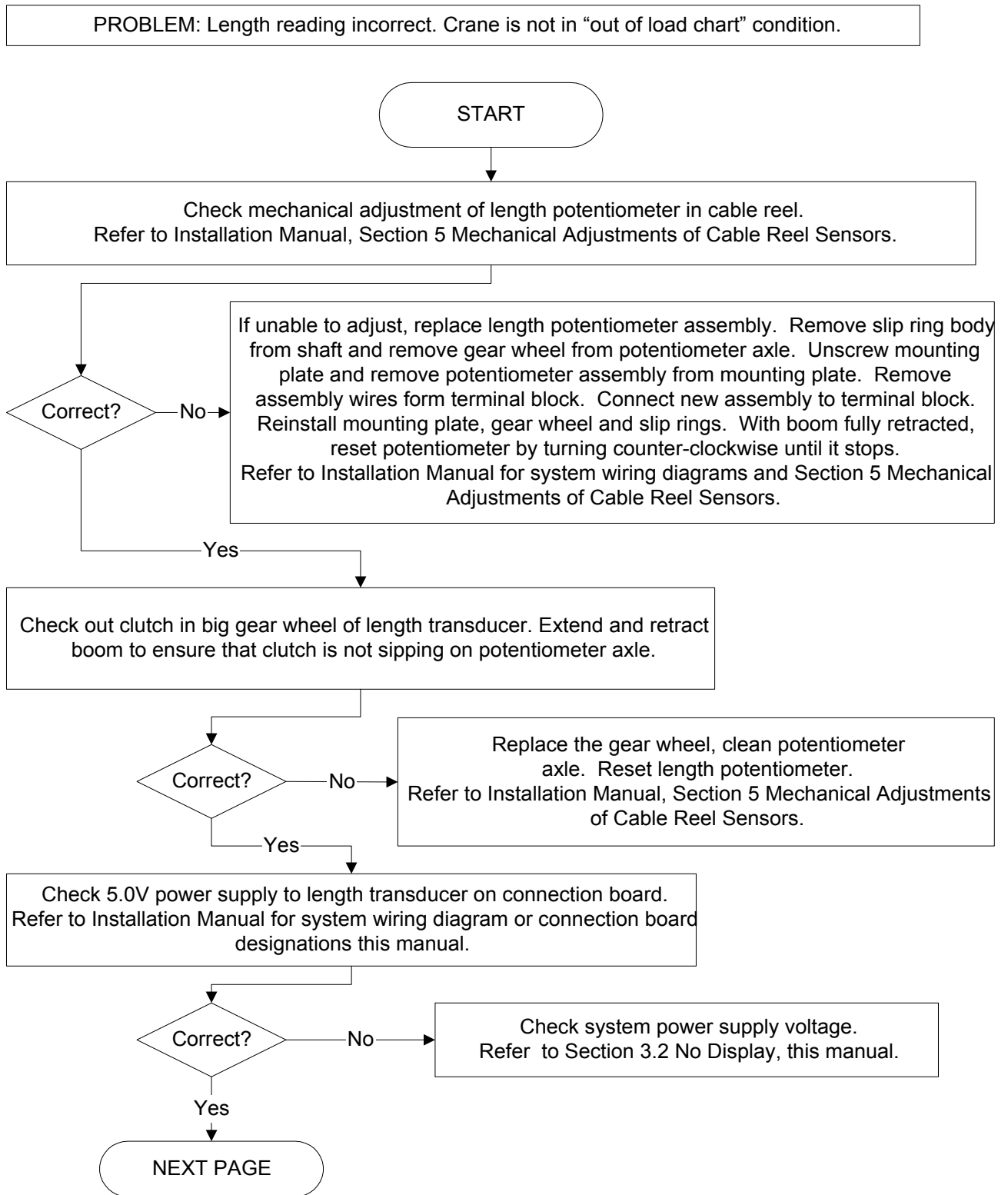
4.3 ANTI TWO BLOCK PROBLEM

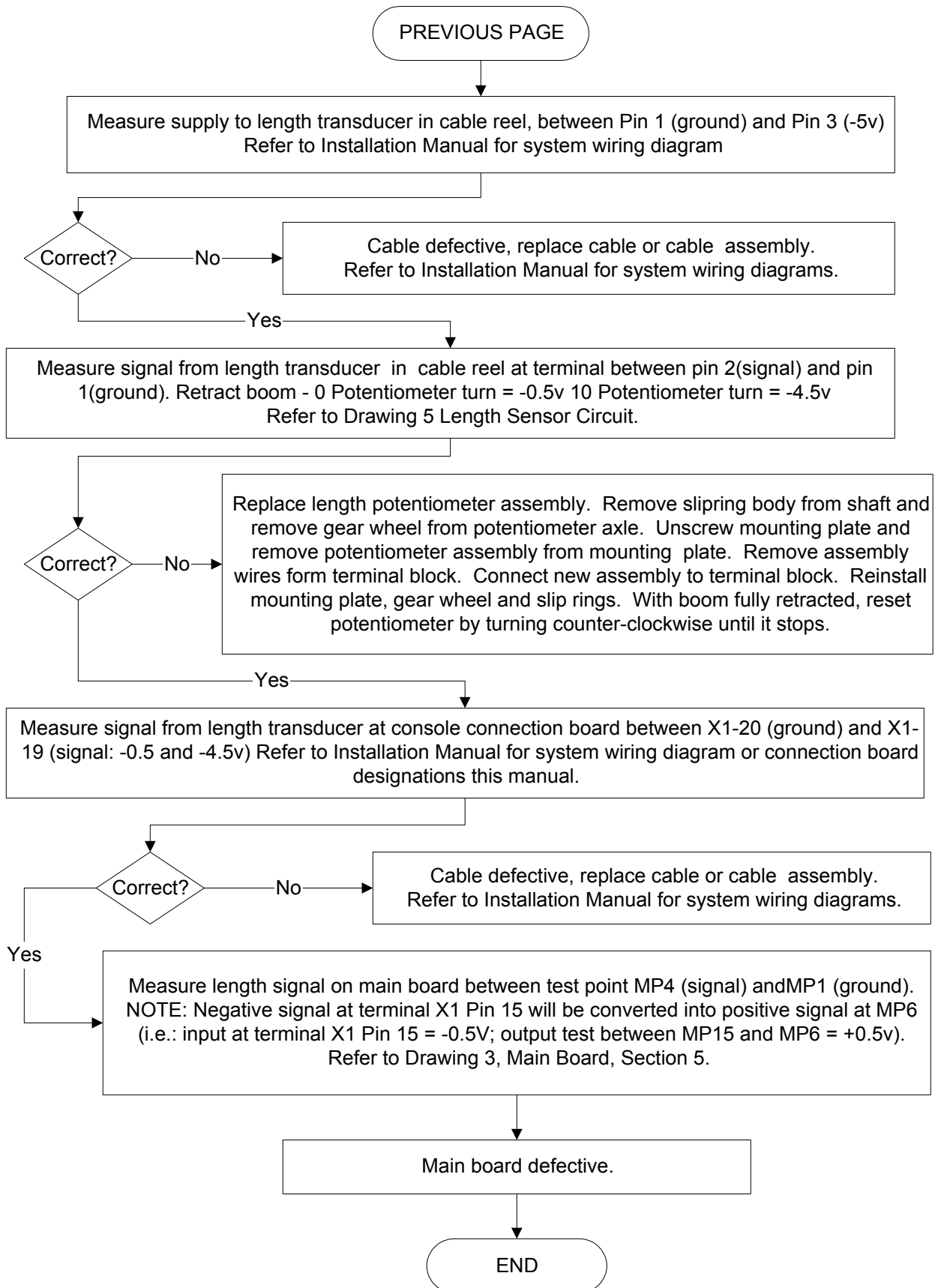


4.4 ANGLE READING PROBLEM



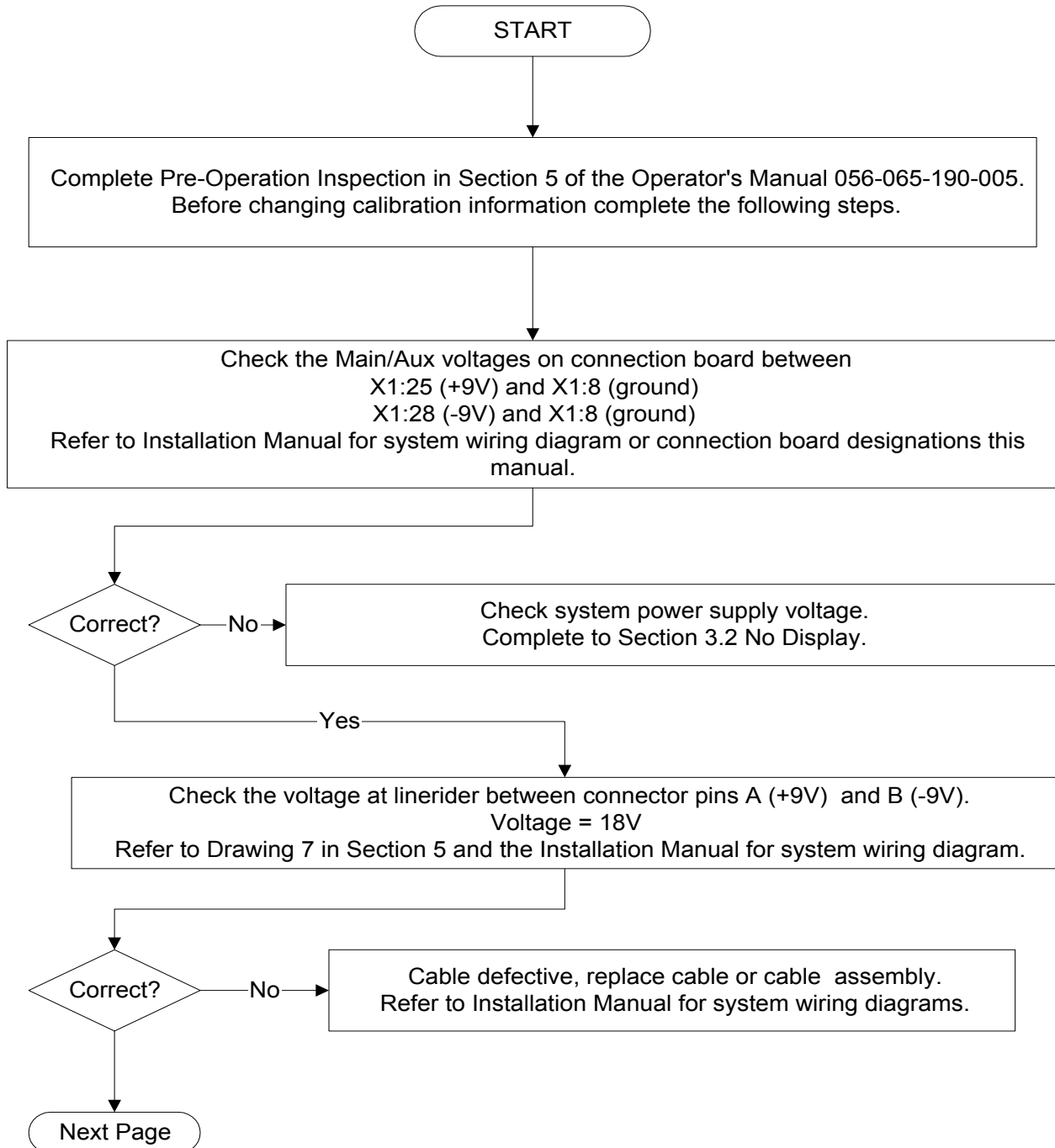
4.5 LENGTH READING PROBLEM

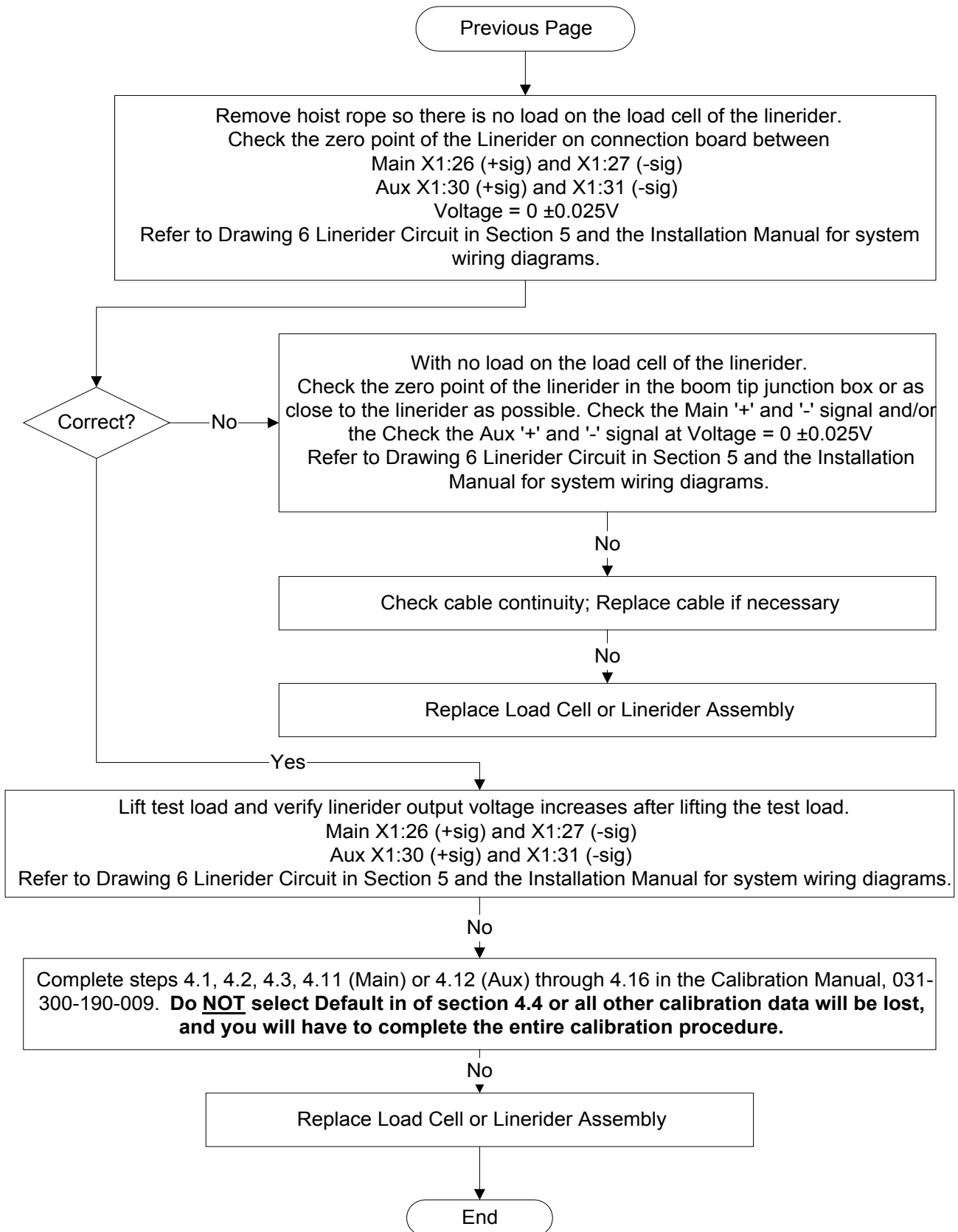




4.6 LOAD READING PROBLEM

PROBLEM: Displayed Load is out of tolerance. The displayed load should be equal to or 10% greater than the actual load.





5 ERROR CODE TABLE

Error code	Reason	Action
11	Operating data in the buffered RAM	Turn on the system again and adjust operating data
21	Crane parameters in the serial EPROM incorrect	Re-calibrate the system
31	Wrong EPROM programming or EPROM defective	Exchange EPROM
51	Short circuit min layer device term 11&12	Check minimum layer device
52	Cable break min layer device term 11&12	Check minimum layer device
53	Short circuit A2B -switch - 2 term 13&14	Check anti-two block system
54	Cable break A2B -switch - 2 term 13&14	Check anti-two block system
55	Short circuit A2B -switch - 1 term 9&10	Check anti-two block system
56	Cable break A2B -switch - 1 term 9&10	Check anti-two block system
•61	Load on the main hoist hook too big	Reduce load on main hoist
•63	Load on the auxiliary hoist hook too big	Reduce load on aux. hoist
•71	Limit Length - Main - Boom - Max.	Decrease length limit
•72	Limit Length - Main - Boom - Min.	Increase length limit
•73	Limit WG - Main - Boom - Max.	Decrease main boom angle
•74	Limit WG - Main - Boom - Min.	Increase main boom angle
•75	Limit Boom height - Max.	Decrease main boom angle
•76	Limit Boom height - Min.	Increase main boom angle
•77	Limit Working radius - Max.	Increase main boom angle
•78	Limit Working radius - Min.	Decrease main boom angle
81	ADC-Measuring value KMD1 voltage too low	Check zero point in linerider
82	ADC-Measuring value KMD1 voltage too high	Check zero point in linerider
83	ADC-Measuring value KMD2 voltage too low	Check zero point in linerider
84	ADC-Measuring value KMD2 voltage too high	Check zero point in linerider
91	ADC-Measuring value LG1 voltage too high	Check main length sensor circuit
92	ADC-Measuring value LG1 voltage too low	Check main length sensor circuit
93	ADC-Measuring value WG1 voltage too low	Check main angle sensor circuit
94	ADC-Measuring value WG1 voltage too high	Check main angle sensor circuit
95	ADC-Measuring value WG2 voltage too low	Check luffing angle sensor circuit
96	ADC-Measuring value WG2 voltage too high	Check luffing angle sensor circuit

- Limit set by the operator refer to Operator's Manual, Section 4.3. Activating and Setting Preset Limits

6 SYSTEM DRAWINGS

The PAT EI65 System drawings in this section are provided as reference material for the troubleshooting flow charts. Use the drawings in conjunction with the flow charts to help understand the operation of the EI65 system.

Drawing List:

1. System Diagram
2. Connection Board Layout
3. Main Board Layout
4. Anti-Two Block Circuit
5. Angle Sensor Adjustment
6. Angle Sensor Circuit
7. Linerider Circuit

Refer to the Operator's Manual for basic component layout on the crane and console drawing. The EI65 console connection board has the following terminal designations.

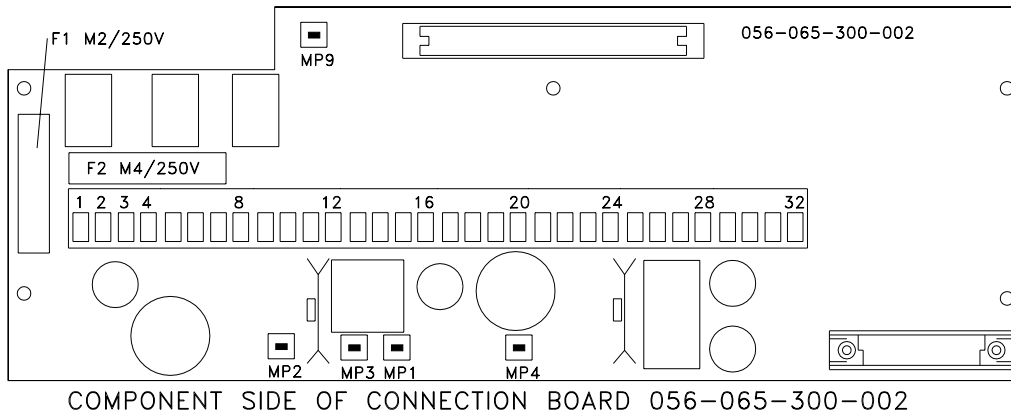
Connection Board 056-065-300-002 Designations:

1	+ Battery
2	+ Battery
3	- Battery
4	- Battery
5	Load Limit output
6	A2B Relay output 2
7	A2B Relay output 1
8	Peripheral ground
9	A2B 1 input
10	A2B Ground
11	A2B 2 input
12	A2B Ground
13	3rd Wrap Switch input
14	3rd Wrap Switch ground
15	Digital input 1
16	Digital input 2

17	+5VDC
18	Main Boom angle input
19	Main Boom Length input
20	Analog Ground
21	+5VDC
22	Jib Angle input
23	Analog Ground
24	Analog Ground
25	+9VDC
26	KMD1 +Signal input
27	KMD1 -Signal input
28	-9VDC
29	+9VDC
30	KMD2 +Signal input
31	KMD2 -Signal input
32	-9VDC

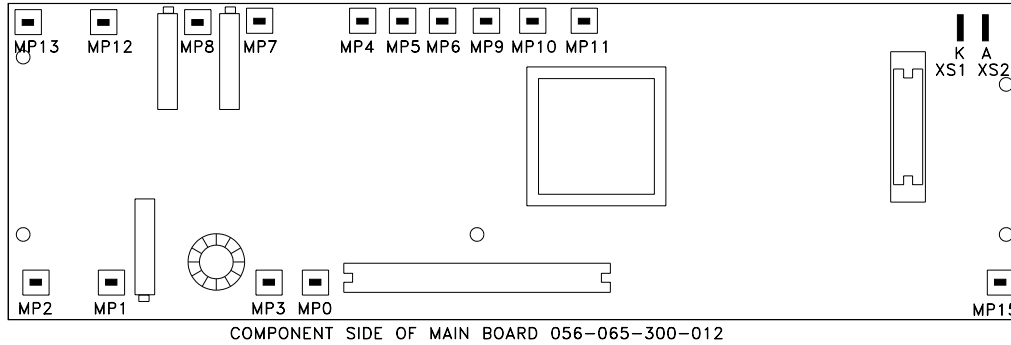
6.1 DRAWING 1. SYSTEM WIRING DIAGRAM (REFER TO INSTALLATION MANUAL 031-300-190-008)

6.2 DRAWING 2. CONNECTION BOARD LAYOUT

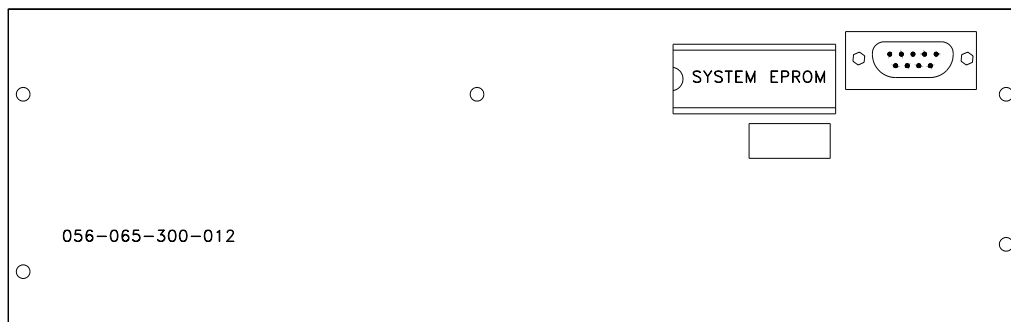


MP1 = GND
 MP2 = 5.6V
 MP3 = 5.6V
 MP4 = .5V min sig.
 To 4.5V max sig.

MAIN BOARD LAYOUT



6.3 DRAWING 3.

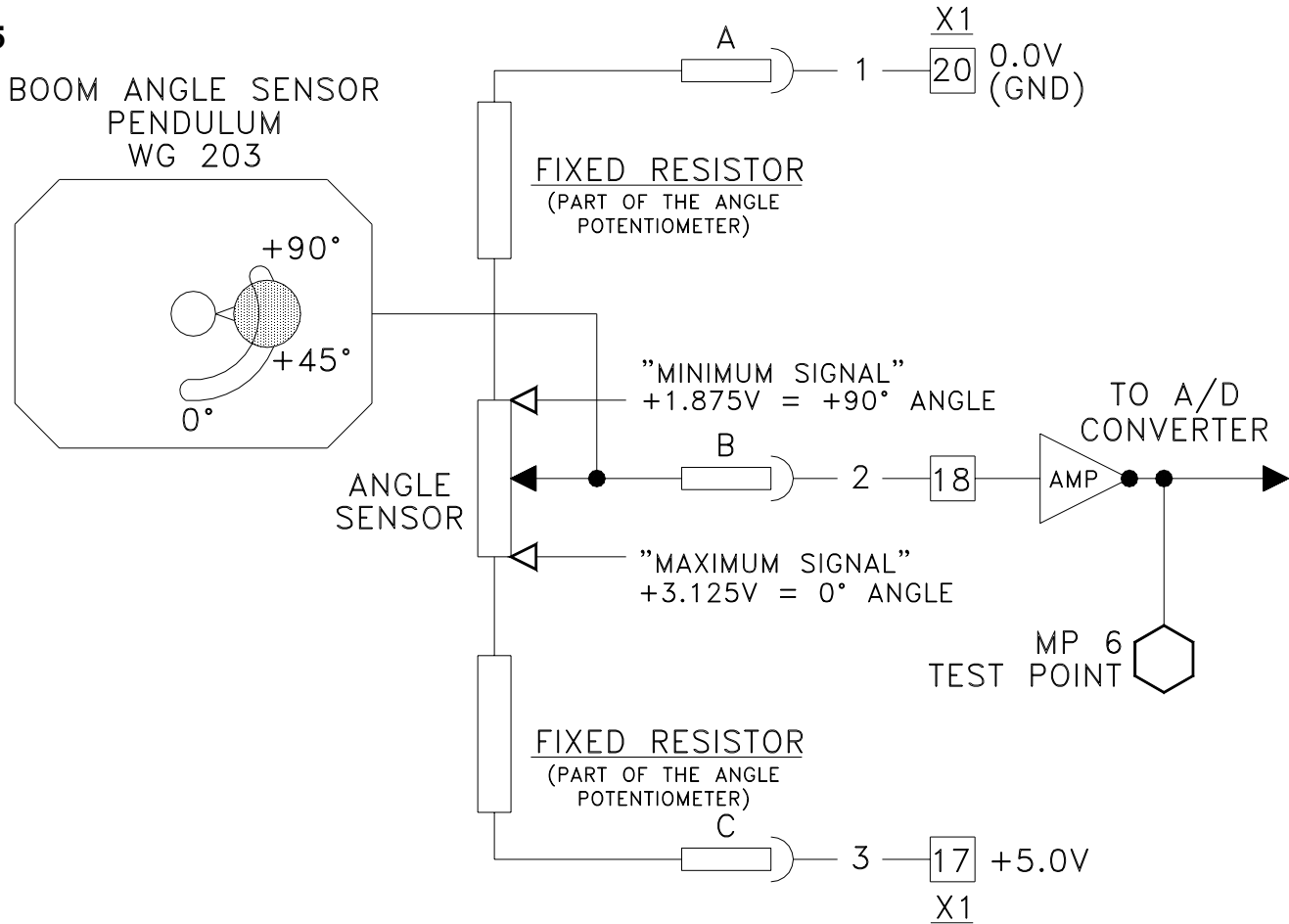


MP0 = GND
 MP1 = AGND
 MP2 = +5.0V
 MP3 = +5.0V
 MP4 = SIGNAL, LENGTH CHANNEL
 MP5 = SIGNAL, ANGLE 2
 MP6 = SIGNAL, ANGLE 1
 MP7 = SIGNAL, KMD1

MP8 = SIGNAL, KMD2
 MP9 = AN5 REFERENCE VOLTAGE
 MP10 = AN6 REFERENCE VOLTAGE
 MP11 = AN7 REFERENCE VOLTAGE
 MP12 = -0.5V
 MP13 = +5.0V
 MP15 = 5.25V

6.4 DRAWING 4, ANGLE SENSOR CIRCUIT

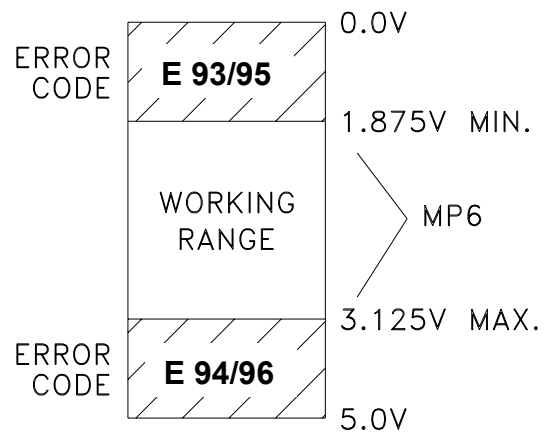
6.5



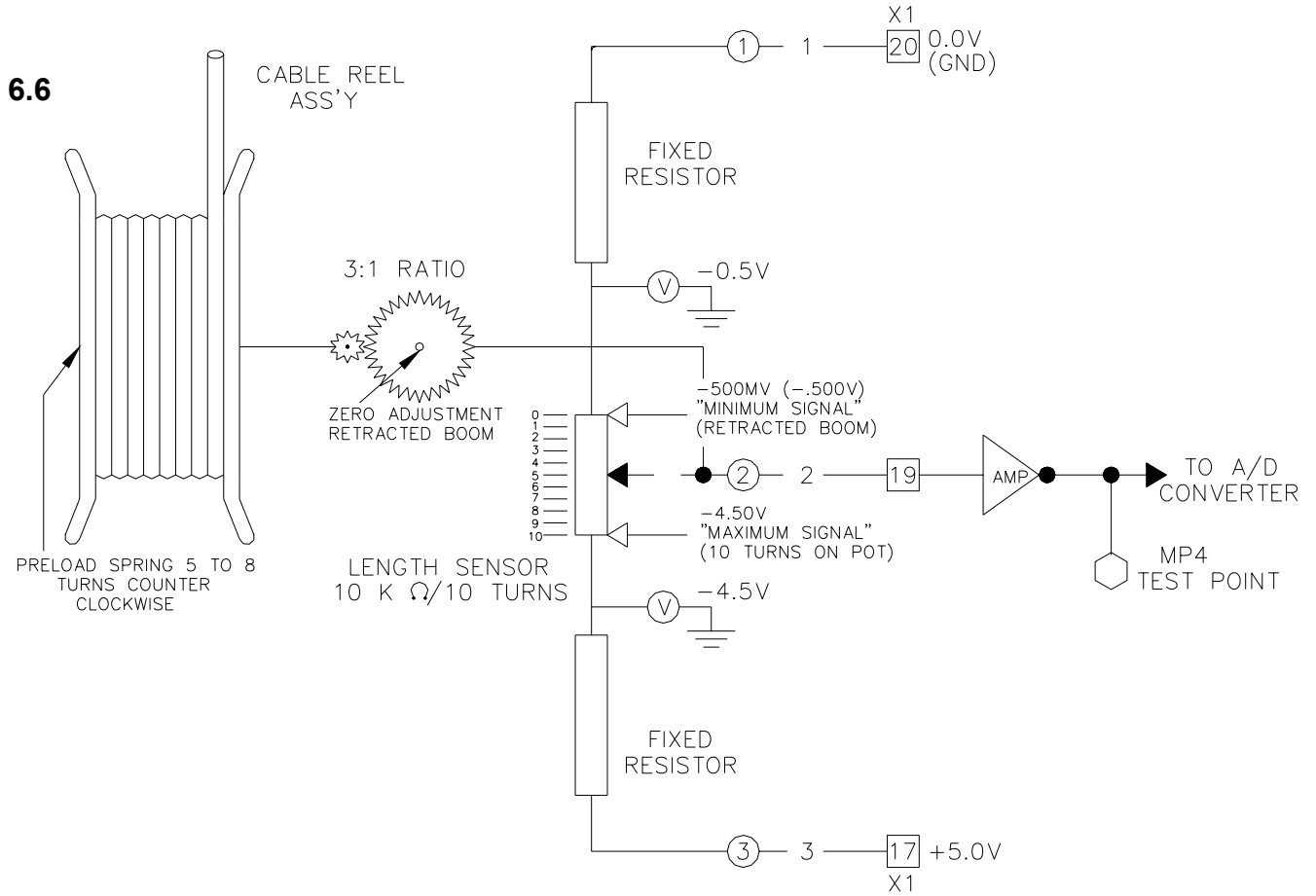
NOTE: MINIMUM AND MAXIMUM VOLTAGES ARE MEASURED ON THE TERMINAL BOARD X1-18 TO 20.

"MINIMUM SIGNAL"
+1.875V = +90° ANGLE

"MAXIMUM SIGNAL"
+3.125V = 0° ANGLE



DRAWING 5, LENGTH SENSOR CIRCUIT

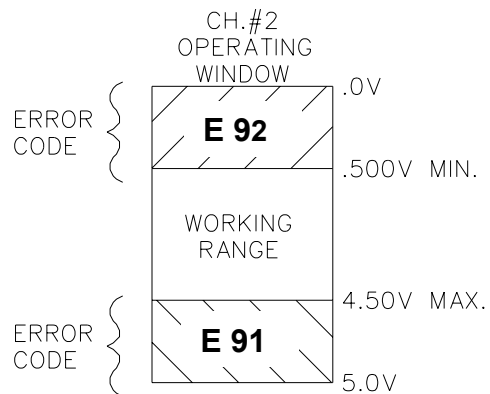


MP4 VOLTAGES

+500mV (.500V) = MIN. SIGNAL (RETRACTED BOOM)

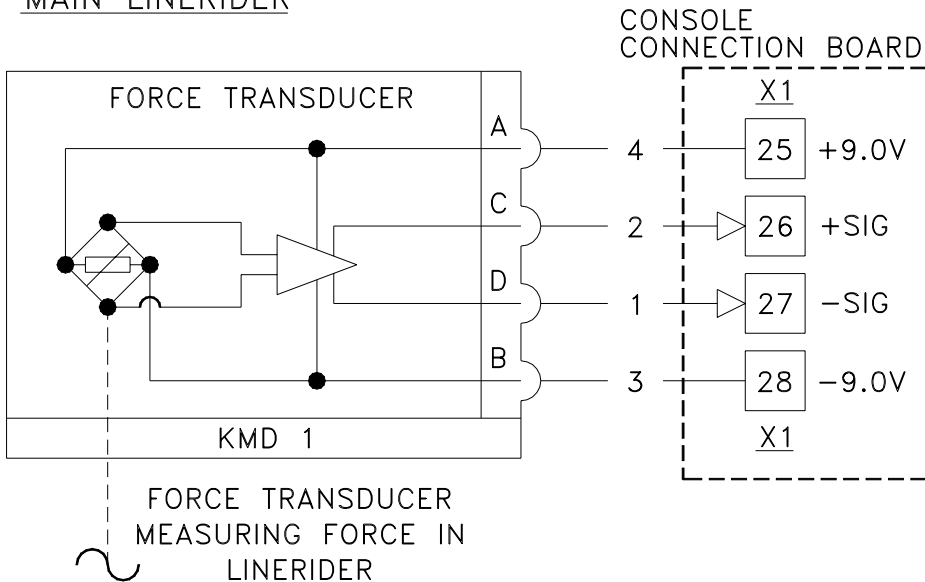
+4.50V = MAX. SIGNAL (10 TURNS ON POT)

ALL VOLTAGES ARE MEASURED WITH REFERENCE TO GND (TERMINAL X1:20 OR MPO) ON MAIN BOARD

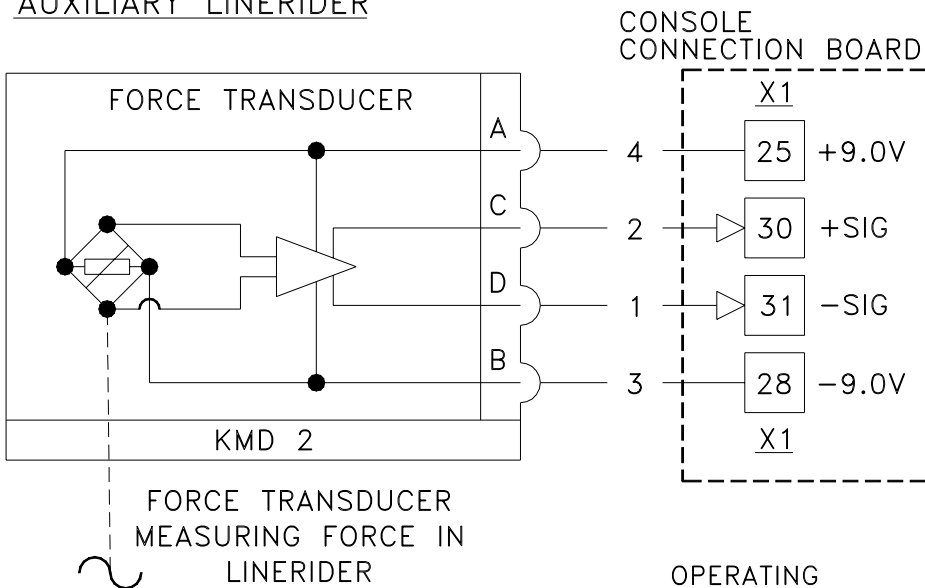


DRAWING 6, LINERIDER CIRCUIT

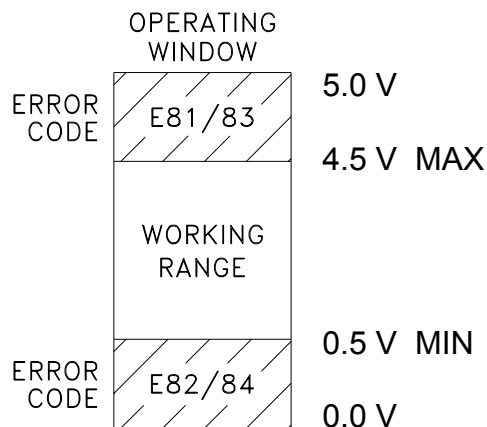
MAIN LINERIDER



AUXILIARY LINERIDER

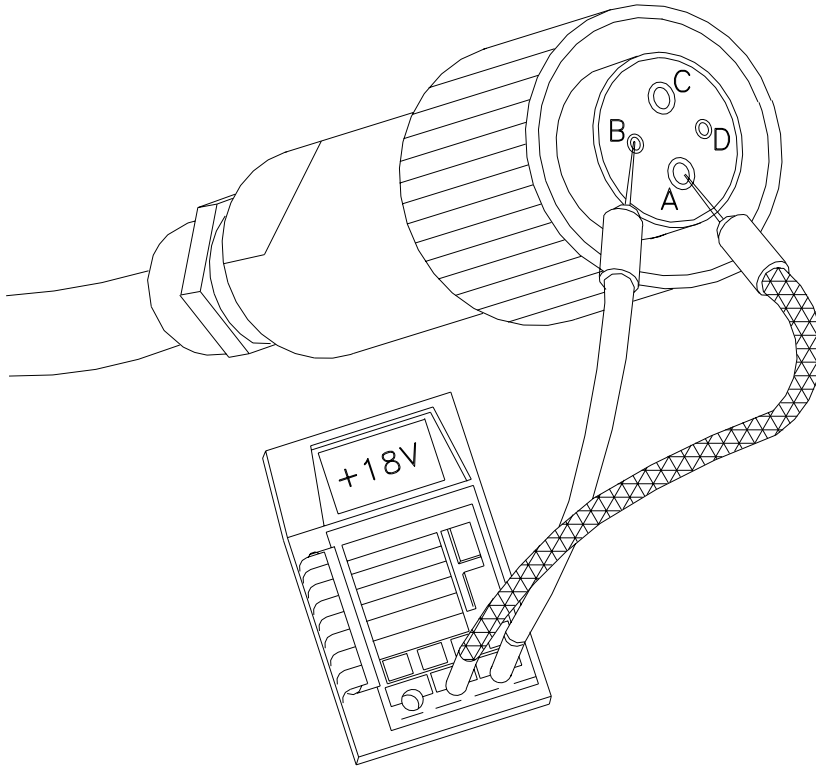


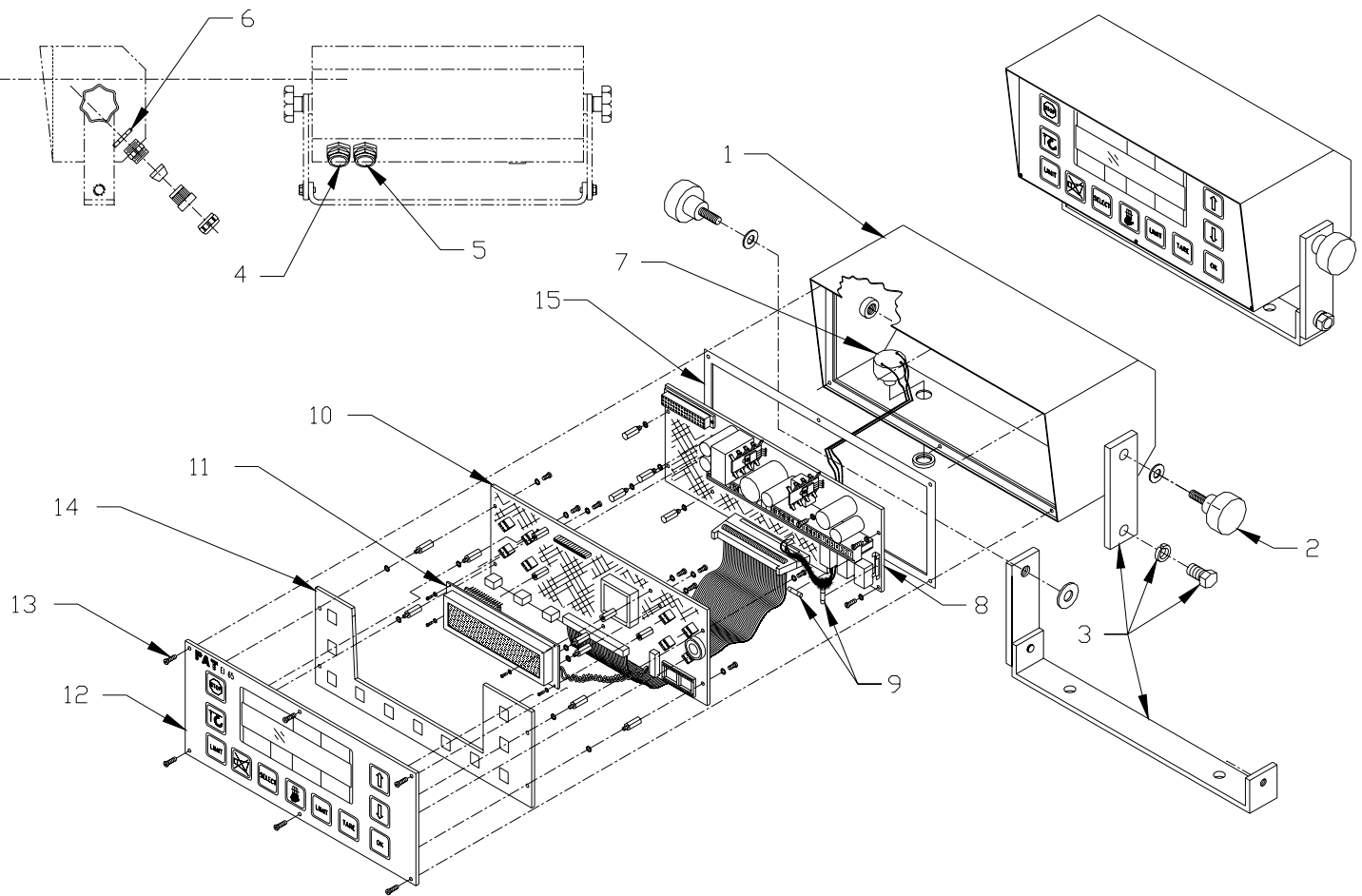
DIFFERENTIAL OUTPUT SIGNAL
 MAIN LINERIDER X1-26 & 27
 AUX LINERIDER X1-30 & 31
 ZERO FORCE = 0.0V ±25mV
 MAX. RATED FORCE = 2.5V



6.7 DRAWING 7, LINERIDER SUPPLY VOLTAGES

The supply voltage can be checked directly at the cannon connection. Using a digital voltmeter measure between pins A and B, (A= +9v) + (B= -9v) = 18volts. If this voltage is not correct refer to the system wiring diagram and verify all cable connections. You may need to start at the console and check the supply voltages at their proper measuring points.



6.8 DRAWING 8, CONSOLE PARTS LIST

NO.	PART NO.	QTY	DESCRIPTION
01	050-000-100-075	1	HOUSING, CONSOLE, EI65
02	050-350-110-183	2	KNOB, MOUNTING KNOB
03	031-300-100-293	1	BRACKET, MTG. EI65 CONSOLE
04	021-441-161-213	1	STRAIN RELIEF, PG13.5, 12-15mm GRAY+WHITE INSERT
05	021-441-131-013	1	STRAIN RELIEF, PG 13.5, 8-12mm RED+WHITE INSERT
06	000-214-210-013	2	NUT, PG13.5
07	000-323-010-525	1	ALARM, A2B, EI10, EI20
08	056-065-300-002	1	BOARD, TERMINAL EI65, 12V
09	031-300-100-294	2	FUSE, 4 AMP FOR EI-65 CONSOLE
10	056-065-300-010	1	BOARD, MAIN EI65 W/RIBBON CABLE
11	050-000-100-078	1	DISPLAY
12	056-065-100-005	1	FACEPLATE, EI65/0005 CONSOLE
13	002-053-703-101	6	SCREW, 3x10mm, PANHEAD, PHILLIPS
14	056-065-300-011	1	BOARD, KEYBOARD, EI 65 CONSOLE
15	050-000-050-309	1	GASKET 108X256mm