



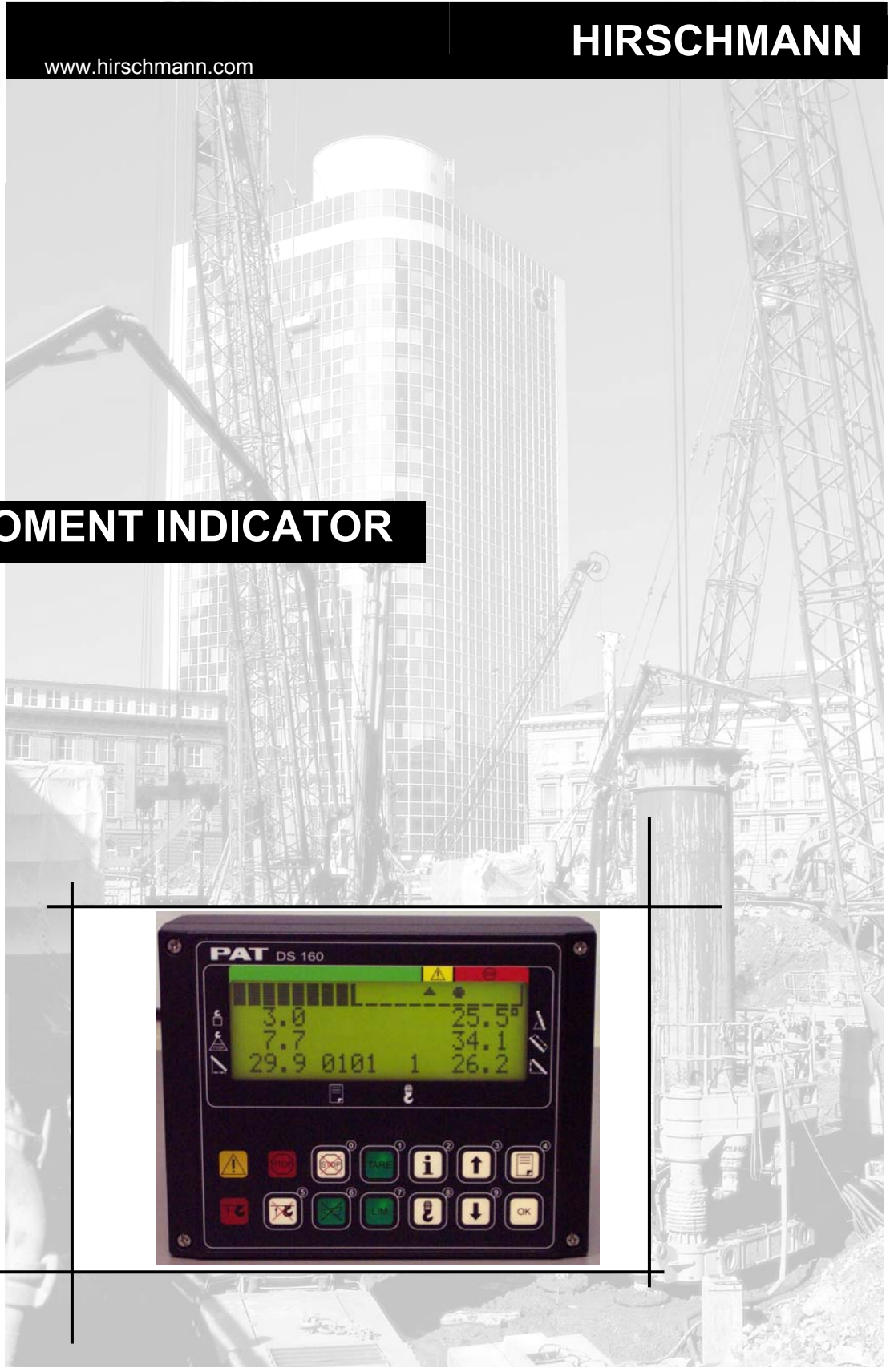
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PAT

LOAD MOMENT INDICATOR

DS 160



OPERATOR'S MANUAL

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1 GENERAL INFORMATION

The Hirschmann Load Moment Indicator ¹ (LMI) DS 160 has been designed to provide the crane operator with the essential information required to operate the machine within its design parameters. The LMI provides the operator with information regarding the length and angle of the boom, working radius, rated load and the total calculated weight being lifted by the crane.

The DS 160 LMI basically consists of a central microprocessor unit, operator's console, length and angle sensor, pressure transducer sensor, and anti-two block switches. The system operates on the principle of reference/real comparison. The real value, resulting from the load measurement is compared with the reference data, stored in the central processor memory and evaluated in the microprocessor. If non permitted conditions are approached, the DS 160 LMI will warn the operator by sounding an audible alarm, lighting a warning light and locking out those functions that may aggravate or worsen the crane's condition.

2 WARNINGS

The LMI is an operational aid that warns a crane operator of approaching overload conditions and of over hoist conditions that 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 crane operation 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 indicator and crane.

Proper functioning depends upon proper daily inspection and observance of the operating instructions set forth in this manual. Refer to Section 6. Pre-Operation Inspection and Calibration Verification of this handbook.



The LMI can only work correctly, if all adjustments have been properly set. For correct adjustment, the operator has to answer thoroughly and correctly all questions asked during the setup procedure in accordance with the real rigging state of the crane. To prevent material damage and serious or even fatal accidents, the correct adjustment of the LMI has to be ensured before starting the crane operation.

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

¹ LOAD MOMENT: generally the product of a force and its moment arm; specifically, the product of the load and the load-radius. Used in the determination of the lifting capacity of a crane

3 SYSTEM DESCRIPTION

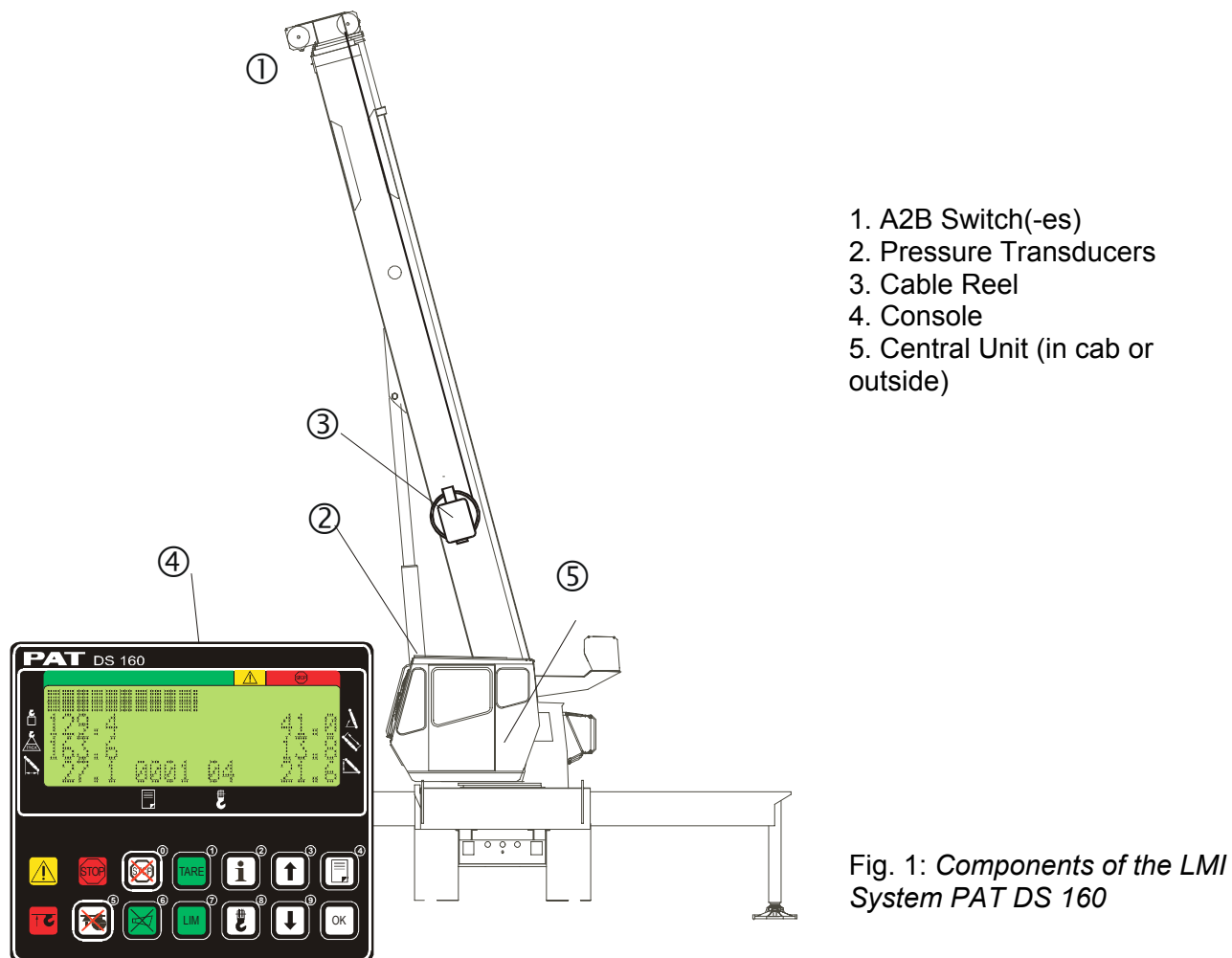
The PAT Load Moment Indicator DS 160 consists of a central microprocessor unit, operating console, length/angle sensor, pressure transducers, and anti-two block switches.

The system operates on the principle of reference/real comparison. The real value, resulting from the load measurement is compared with the reference data, stored in the central processor memory and evaluated in the microprocessor. When limits are reached, an overload warning signal is generated at the operator's console. At the same time, the crane functions, such as hoist up, boom down and telescoping out will be stopped.

The fixed data regarding the crane, such as capacity charts, boom weights, centers of gravity and dimensions are stored in memory chips in the central processor unit. This data is the reference information used to calculate the operating conditions.

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

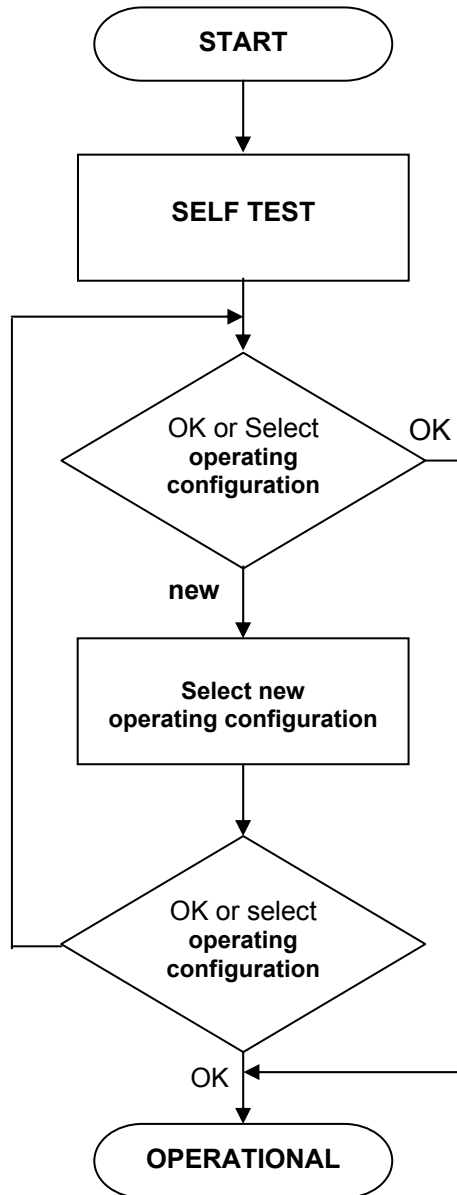
The crane load is measured by pressure transducers attached to the piston and rod sides of the hoist cylinders.



1. A2B Switch(-es)
2. Pressure Transducers
3. Cable Reel
4. Console
5. Central Unit (in cab or outside)

Fig. 1: Components of the LMI System PAT DS 160

3.1 SYSTEM FUNCTION



Upon switching on crane ignition switch, the system starts with an automatic test of the LMI system, of lamps and audible alarm. During the test, the LC Display shows the crane model and serial number.

The last selected operating mode will be displayed and must only be confirmed OK if that configuration setup equals the crane's actual configuration. Otherwise it must be deleted to enter a new configuration. (⇒ chapter 4)

When operating in the Manbasket configuration the system will default to the previously selected Manbasket operating screen, eliminating the need for the operator to acknowledge the configuration from the cab. (⇒ chapter 4)

The operating configuration is determined by selecting from a list of possible operating configurations. (⇒ chapter 4)

The configuration setup entered will be displayed and the reeving (parts-of-line) must be entered. (⇒ chapter 4)

Upon acknowledgment of the inputs the system is ready for operation.

3.2 OPERATING CONSOLE

The console has 3 functions:

- **inputs by the crane operator (operating configuration, reeving, and calibration)**
- **input of geometry limit values and signalization of exceeded limit values**
- **display of important data and information**

The operator's console is mounted in the operator's field of vision. For a better identification of displays and operating elements, they are continuously backlit during operation.

3.2.1 LC Display

The LC display (LCD) used in the PAT DS 160 operator's console is a wide temperature-range alphanumeric display with transfective characteristics that give it a high visibility in sunlight and during backlit night operation. Due to the nature of any LCD, it works on the principle of polarization of light. It should be noted that dual polarizations that are at a certain angle to each other can reduce the amount of light up to completely eliminating it if that angle becomes perpendicular. This can have significance if the operator is wearing polarized sunglasses that happen to be perpendicularly polarized in relation to the LCD's polarization. In this rare case, the operator has to work without sunglasses or find different sunglasses that do not have this characteristic, in order to avoid having the visibility of the display impaired.

The LCD contains an automatic temperature compensation that will adjust the LCD's contrast according to the surrounding temperature.

3.2.2 Control Identification

This unit contains a display and different controls that are described as follows:

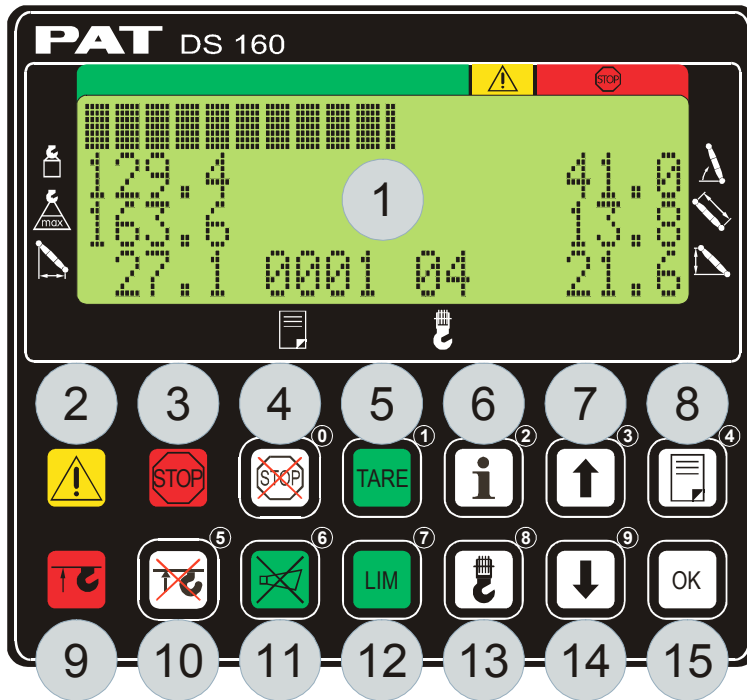
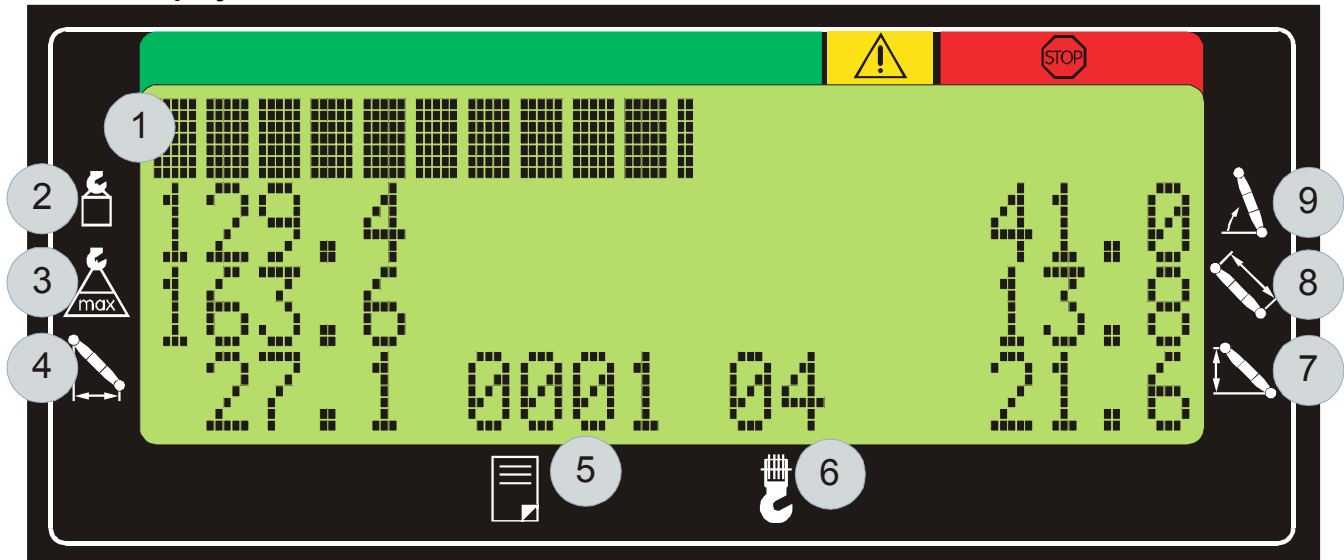


Fig 2: Operator's Console

1. LCD Area
2. Load Moment Prewarning Light
3. Load Moment Limit Light
4. Button "BY-PASS LMI Lock-out function"
5. Button "Tare"
6. Button "info"
7. Button "SCROLL UP"
8. Button "SELECT OPERATION MODE"
9. Alarm Light "Anti-Two-Block"
10. Button "BY-PASS Anti-Two-Block"
11. Button "Alarm Stop"
12. Button and Control Light "LIMITS"
13. Button "REEVING (Parts-Of-Line)"
14. Button "SCROLL DOWN"
15. Button "OK"

1 LC-Display



The LCD visualizes texts and numerical values:

- | | |
|-------------------------|----------------------------|
| 1. Load Moment Bargraph | 6. Reeving (Parts-Of-Line) |
| 2. Actual Load | 7. Tip Height |
| 3. Capacity (Max. Load) | 8. Boom Length |
| 4. Load Radius | 9. Boom Angle |
| 5. Operating Mode | |

2 Load Moment Pre-warning Light



The yellow LOAD MOMENT PRE-WARNING LIGHT (2) will light up when the load on the crane reaches the defined pre-warning area, thus indicating that an overload condition is approaching.

This means for the operator to continue his crane operation with extreme caution.

3 Load Moment Limit Light



The red LOAD MOMENT LIMIT LIGHT (3) warns the operator that a rated load condition has been reached. It lights up when the load on the crane reaches the crane load capacity. The audible alarm also sounds when this condition has been reached.

The following crane movements will be stopped concurrently:

- **Hoist up**
- **Boom down**
- **Telescope Out**

Crane lockouts are dependent on crane models, if lockouts do not function as described refer to crane manufactures documentation.

4 Button "By-pass LMI"

While pushing this button, the control lever lockout function of the LMI is deactivated.

⚠ WARNING

Since buttons (4) and (10) deactivate the kick-out function of the LMI system / the anti two-block system, the following instructions must be obeyed:

- The by-pass function shall be used with discretion, as unwarranted use of it to override the control lever lockout system can result in harm to the crane and danger to property and persons.
- Never use the by-pass function to either overload or operate the crane in a non-permissible range.

5 Button "Tare"

The button "TARE" is used to indicate the "Net load" on the LCD. Net load is the present load, less lifting tackle and hook block. The Tare Button has to be activated *before* lifting.

After pushing the "Tare Button" the load display is set to zero (taring) and the control light lights up. After lifting a load the display shows the *net load* (pay load). The *net load* display will change to the actual load display when the boom radius is changed (either by angle or length).

6 Button "info"

Use this button to access screens that give additional information.

7 Button "SCROLL UP"

Use this button to increase values or to scroll up.

8 Button "SELECT OPERATION MODE"

Use this button to start the function "set operating mode".
For the proceeding please refer to ⇒ chapter 4.1.


WARNING

The correct setting is of utmost importance for the proper function of the system and the crane. Therefore only operators who are thoroughly familiar with use and operation of the system shall set this button.

9 Alarm Light "Anti-2-Block"

The red "Anti Two-Block Alarm Light" lights 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 will sound. The following crane functions will be disabled subsequently: hoist up, telescope out, and boom down (refer to DS160 service manual or the crane owner's manual for a complete description of the anti-two-block system).

10 Button "By-pass A2B"

While pushing this button, the lockout function of the anti-two-block switch is deactivated.


WARNING

Since buttons (4) and (10) deactivate the kick-out function of the LMI system / the anti two-block system, the following instructions must be obeyed:

- The by-pass function shall be used with discretion, as unwarranted use of it to override the control lever lockout system can result in harm to the crane and danger to property and persons.
- Never use the by-pass function to either overload or operate the crane in a non-permissible range.

11

Button and Control Light "Alarm Stop"

This ALARM STOP BUTTON allows for the audible alarm to be silenced for approximately 15 seconds by pressing this button.

12

Button "LIMITS"

Button to start the function "program limit values".
For the proceeding please refer to ⇒ chapter 5.1.

13

Button "REEVING (Parts-Of-Line)"

Button to start the function "select parts of line"
Please refer to ⇒ chapter 4.2.

14

Button "SCROLL DOWN"

Use this button to decrease values or to scroll down.

15

Button "OK"

Use this button to confirm settings.

4 SYSTEM OPERATION

The LMI setup procedure allows the operator to input the crane configuration. The operator must complete the configuration setup procedure for the Load Moment Indicator system by confirming (pressing OK) to set the system into operation or changing it to enter a new configuration. The previous configuration setup will be displayed and must match the current crane operating configuration.

4.1 LMI SETUP PROCEDURE

If the system is turned off, all adjustments remain stored. When turning the system on again these adjustments can be acknowledged by merely pressing the OK button (provided that the crane configuration has not been modified!).

**When operating in the selected Manbasket configuration, all adjustments will remain stored after the system is turned off. Only when operating in the Manbasket configuration will the system default to the previously selected Manbasket operating screen, eliminating the need for the operator to acknowledge the configuration from the cab.*

During the programming procedure the Load Moment Prewarning Light (2) and the Load Moment Limit Light (3) will light up and the crane functions will be interrupted.

Note: *If a configuration is selected which is not available, the display will indicate error code E04. In this case, the procedure has to be repeated with valid values!*



The correct setting is of utmost importance for the proper functioning of the system and the crane. Therefore, only operators who are thoroughly familiar with the crane and the operation of the system should execute the setting of the system according to the operating configuration of the crane.

The LMI programming procedure consists of the following steps:

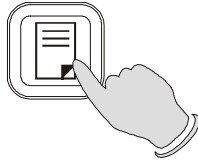
- **set the operating mode (crane configuration)**
- **select the outrigger configuration**
- **verify crane is level**
- **select the hoist in use (for machines with dual hoist option)**
- **select the reeving (parts-of-line)**

For easy operation, the computer guides the operator through the procedure step by step. (interactive operation)

4.1.1 Operating Mode Selection


...starts:

- **Manually** after each modification of the crane configuration by pressing "SELECT OPERATION MODE" (8) button.




A screen similar to the following one will appear:



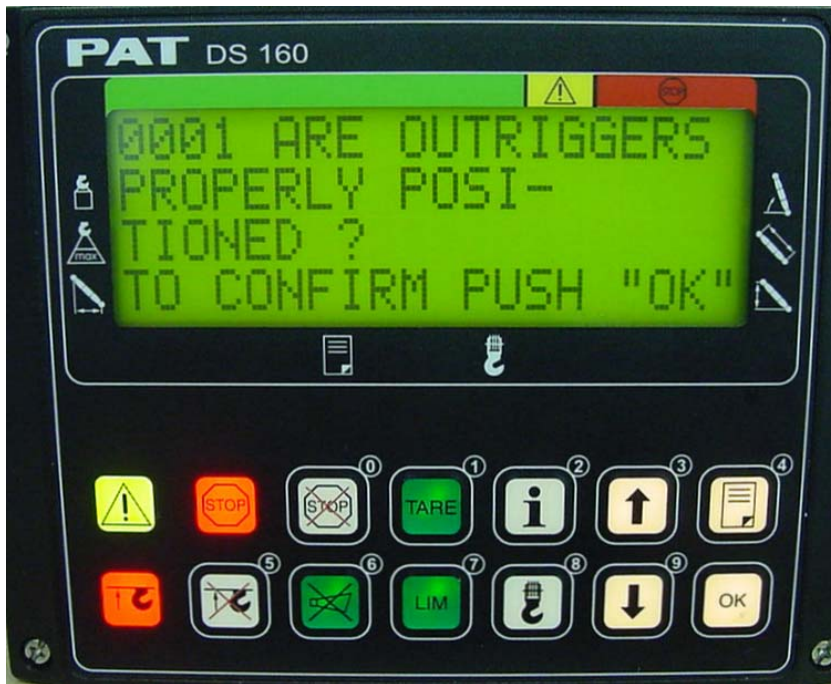
If this operating mode corresponds with the current machine configuration, press .


Otherwise, use the scroll buttons  and  to scroll between the possible operating modes (configurations) of your machine.



When you have found the operating mode that corresponds with the current machine configuration, press . This will automatically bring you to the ...


4.1.2 Outrigger Selection Screen

A screen similar to the following one will appear for the outrigger selection.



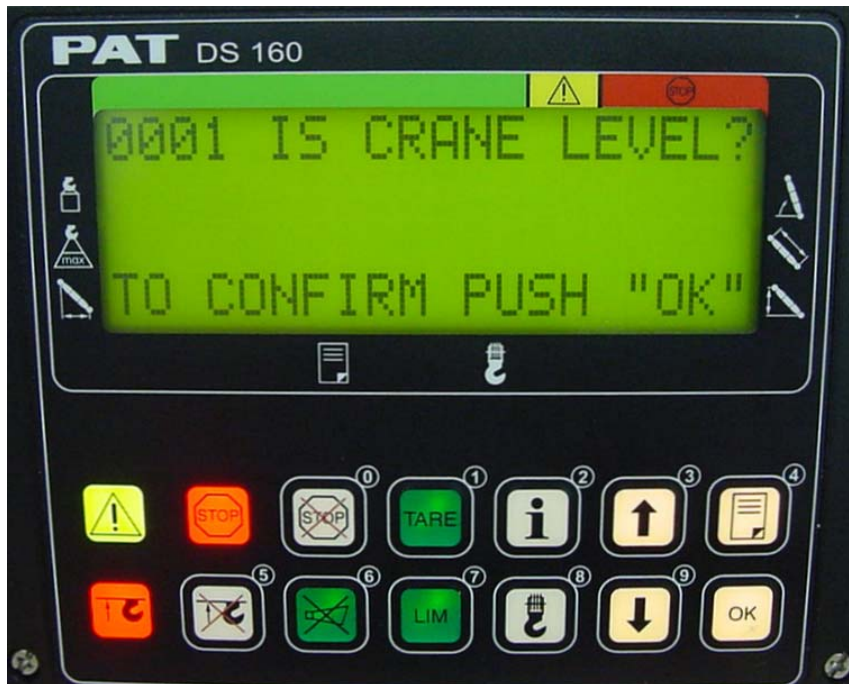
If this outrigger selection corresponds with the current machine configuration, press .


Otherwise, use the scroll buttons  and  to scroll between the possible outrigger selections for your machine.

When you have found the outrigger selection that corresponds with the current machine configuration, press . This will automatically bring you to the ...

4.1.3 Crane Level Screen

A screen similar to the following one will appear verifying if the crane is level.




If the crane is level, press . If the crane is not level to manufacturer's specification, refer to manufacturer manual, then level crane to specifications.

4.1.4 Hoist Selection Screen

A screen similar to the following one will appear if you have a second hoist option



Use the scroll buttons  and  to toggle between auxiliary and main hoist.

When you have selected the hoist that corresponds with the current machine configuration, press . This will automatically bring you to the ...

4.1.5 Reeving (Parts-of-Line) Selection Screen

...starts:



- *Manually* by pressing "REEVING" (13) button, if the machine is **not** equipped with a dual hoist option.




- *Automatically* after selecting the hoist, if the machine **is** equipped with a dual hoist option.

A screen similar to the following one will appear:



Use the scroll buttons  and  to increase or decrease the number of parts of line until it matches the current reeving of your machine.

When you have selected the correct reeving, press .

This concludes the setting of the reeving and/or operating mode. If you have selected a valid operating mode, the system will bring you back to the operating screen. If you have selected an invalid operating mode, the system will show an E-04.

4.2 LIMIT SETTINGS

The operator has the option to activate a maximum and minimum geometric limit for boom angle, radius, and boom tip height. When a limit is activated, the working screen will display an 'A' in front of the angle indication, 'R' in front of the radius indication, 'H' in front of the tip height indication. When the limit is exceeded the system will alert the operator by sounding an audible alarm, lighting the horn silence button, flashing the limit button, and flashing the letter 'A', 'R', or 'H' on the display. There is no cutout associated with the limit function. Use the following procedure to set or delete a limit.

Press the limit button 'LIM', the following screen will come up:

```

ANGLE
RADIUS
TIP HEIGHT
EXIT
  
```

Use the 'UP' and 'DOWN' arrow buttons to select the limit to set or delete, the selection should now be flashing. Then press 'OK'.

➤ Angle limit setting: The following screen will be displayed

```

SET MAX. ANGLE
SET MIN. ANGLE
DELETE LIMITS
EXIT
  
```

Use the 'UP' and 'DOWN' arrow buttons to select the maximum/minimum angle, delete angle limits, or exit limit function. Then press 'OK'.

```

MOVE BOOM TO
MIN. ANGLE
ANGLE      XX.X DEG
EXIT      "PUSH OK"
  
```

Only one of the functions MIN/MAX can be completed at a time.

MIN Limit
Boom to the minimum angle and press 'OK'.

MAX. Limit
Boom to the maximum angle and press 'OK'.

Use the 'UP' and 'DOWN' arrow buttons to select another angle limit or exit the angle limit function.

➤ **radius limit setting: The following screen will be displayed**

```

SET MAX. RADIUS
SET MIN. RADIUS
DELETE LIMITS
EXIT
  
```

Use the 'UP' and 'DOWN' arrow buttons to select the maximum/minimum radius, delete radius limits, or exit limit function. Then press 'OK'.

```

MOVE BOOM TO
MIN. RADIUS
RADIUS      XX.X FT
EXIT        "PUSH OK"
  
```

Only one of the functions MIN/MAX can be completed at a time.

MIN Limit

Boom to the minimum radius and press 'OK'.

MAX. Limit

Boom to the minimum radius and press 'OK'.

Use the 'UP' and 'DOWN' arrow buttons to select another radius limit or exit the radius limit function.

➤ **Tip height limit setting: The following screen will be displayed**

```

SET MAX. TIP HEIGHT
DELETE LIMITS
EXIT
  
```

Use the 'UP' and 'DOWN' arrow buttons to select the maximum tip height, delete tip height limits, or exit limit function. Then press 'OK'.

```

MOVE BOOM TO
MAX. TIP HEIGHT
TIP HEIGHT  XX.X FT
EXIT        "PUSH OK"
  
```

MAX. Limit

Boom to the maximum tip height and press 'OK'.

Use the 'UP' and 'DOWN' arrow buttons to select another tip height limit or exit the tip height limit function.

5 RADIO ANTI TWO-BLOCK SWITCH (OPTIONAL)



5.1 RADIO ANTI-TWO BLOCK TRANSMITTER AND RECEIVER DESCRIPTION

The anti-two block system alerts to an impending two-block condition. This alert can come in the form of an audible alarm and visual LED on the console face or with the optional function lockout if the crane is so equipped.

The PAT Radio Anti Two Block uses radio communication electronics that transmits an OK signal ~ every two seconds on up to three separate channels. This is to ensure accurate and consistent reception of data and to reduce the possibility of unnoticed failure. The separate channels greatly reduce the probability of failure due to external interferences. Unique, serialized transmitter identifiers are used to ensure proper operation even though other cranes are in the area.

The transmitter is modular by design, containing three separate parts, the transmitter, the switch and the battery housing. It was designed so these individual components can be replaced easily and separately.

The receiver is mounted into a receiver box, which is water-tight when submerged in up to three feet of water. The receiver box provides the following indications: Power (status), LINK, Low Battery, A2B. If battery saving measures are used, the battery life will be greater than one year or up to two years, even with transmitting every two seconds. Several power saving methods are incorporated into the design of the electronics as well as the other hardware.

5.1.1 RECEIVER

**Radio Anti-Two-Block Receiver LEDs:**

POWER (Green)	Shows that there is power to the system.
LINK (Green)	Indicates the status of the communication link between the main hoist A2B transmitter and the receiver. Failure of the communication link will turn off the Green LED and turn off the output to the lockout relay.
LOW BATTERY (Yellow)	Indicates that the battery of the main transmitter needs to be replaced.
A2B ALARM (Red)	Indicates an impending two-block condition of the main hoist. The Red LED will light when the load-handling device has lifted the A2B weight. This LED will light simultaneously with the engaging of the lock out solenoids (if installed).

ID button

The yellow ID button, located in the lower right-hand corner of the receiver board, is used to set the transmitter ID of the transmitter into the receiver.

5.1.2 Transmitter / Switch

The transmitter and battery housing are made of a special plastic that resists impact and will not become brittle even in low temperatures.

Transmitter LED:

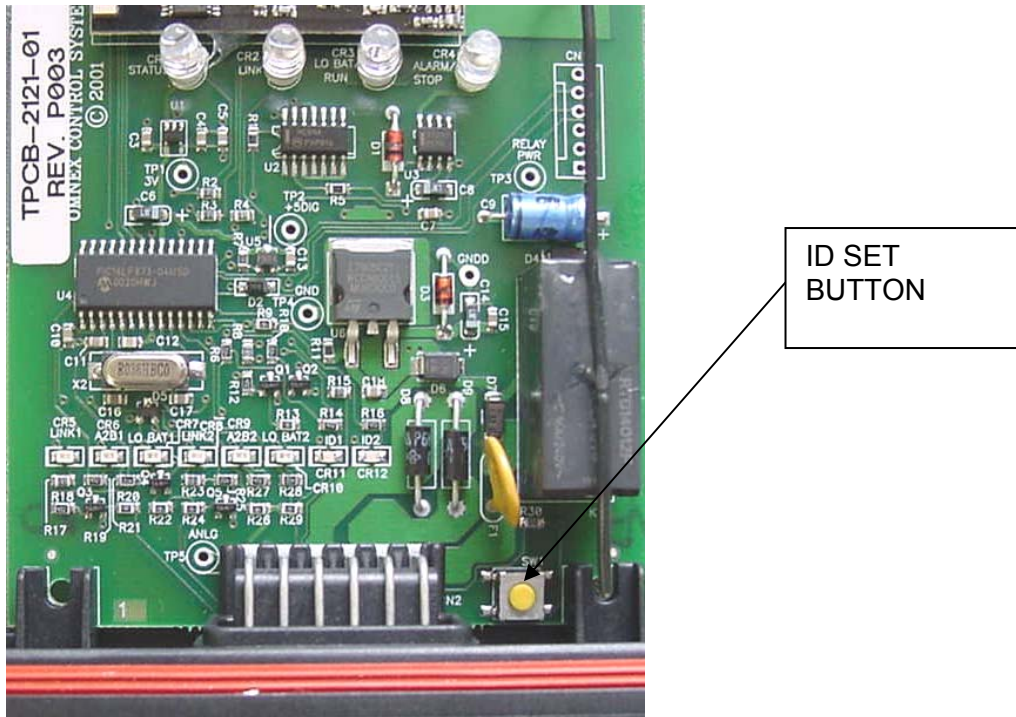
The transmitter has an LED on the bottom for diagnostics. The LED should be on when in a two-block condition or when the weight is lifted. The LED will flash rapidly during a 2-block condition and will stop flashing after the switch is in a two-block condition for more than 15 seconds. The LED will flash randomly approximately every 2 seconds when the switch is transmitting. When in sleep mode, the LED will not flash.

Storage of the A2B transmitter for Travel:

The weight should remove from the switch when traveling to extend battery life. The system is in permanent lockout and the system will not function until the chain is unhooked. To use the feature, attach any part of the chain into the hook. When it is desired to use the switch again, simply unhook the chain to allow the switch to close.



5.2 SETUP



5.2.1 Clear Existing Setup/Switches

Press and hold the yellow “ID” button for 15 seconds, the ID LED will begin to blink and then go off when cleared. Note: It is only necessary to complete this operation when changing from a duel switch setup to a single switch. When setup is complete, the new transmitter switch will over write the old ID code.

5.2.2 First ID Setup

To configure the system, install batteries into the transmitter to be used. Turn on the crane power. Open the receiver enclosure and slide out the receiver board. Press and hold the yellow ID button on the OEM module for 7 seconds until the ID 1 LED blinks. Release the yellow ID button. The receiver will search for a transmitter for the next 30 seconds. Pull on the cable of the transmitter and then release it. The yellow ID 1 LED should now be on solid. The transmitter and receiver are now set up and will work only with each other.

5.2.3 Second ID Setup

To program second radio a2b switch: ground wire 2 from the receiver inside the central unit (refer to system wiring diagram inside the central unit). Install batteries into the transmitter to be used. Turn on the crane power. Open the receiver enclosure and slide out the receiver board. Press and hold the yellow ID button on the OEM module for 7 seconds until the ID 2 LED blinks. Release the yellow ID button. The receiver will search for a transmitter for the next 30 seconds. Pull on the cable of the transmitter and then release it. The yellow ID 1 LED should now be on solid. The transmitter and receiver are now set up and will work only with each other.

5.3 OPERATION

The function of the system must be tested daily before each use of the crane hoist. Refer to Pre-Operation Inspection and Calibration Verification.

During the normal operation of the system the LINK and POWER LED's should be on.

POWER LED

The POWER LED shows that the OEM module is getting power from the crane. The receiver is on any time the crane is operating and supplying power to the system.

LINK LED

The LINK LED indicates the status of communication of the transmitter(s). During normal operation of the system, the LED will be on. The LED is off when there is an interruption in the transmission. The system should not be operated if the LINK LED is not lit.

LOW BATTERY LED

The low battery indicator will light indicating that you have a limited time to operate before the system goes dead. When the battery level is to the point that it is too low to operate, the system will stop functioning. Use any off-the-shelf alkaline C-cells; Duracell, Eveready, etc.

A2B ALARM LED

Indicates an impending two-block condition of the main hoist. The Red LED will light when the load-handling device has lifted the A2B weight. This LED will light simultaneously with the engaging of the lock out solenoids (if installed).

Test the electronics

Cycle the power to the system, each LED on the receiver will light for 2 seconds when the system is powered. All of the indicator lights must come on or the system is not functioning properly. If any light does not function, do not use the system until it has been repaired.

Following the successful testing, the LINK LED should come on. If the LED's do not come on, there is an error in the transmission. Do not use the system until it has been repaired or replaced, refer to the Troubleshooting manual.

6 PRE-OPERATION INSPECTION AND CALIBRATION VERIFICATION

Before operating the crane, the following electrical connections must be checked to ensure that the system is properly connected for the crane configuration.

6.1 MACHINES WITH ONLY A MAIN HOIST

If the crane works only with the boom and without boom extension, no additional connections are necessary. However, be sure the weight of the anti two-block switch is properly installed on the main hoist load line. With even parts of hoisting line, the weight shall be attached to the dead-end line. With odd parts of hoisting line, the weight shall be attached to the line of lowest speed.

If the crane works with boom extension, the connecting cable shall be installed between the junction box on the boom extension and the boom junction box. The weight attached to the main hoist anti two-block switch shall be removed. In that case the anti two-block switch has to be locked with the red Anti Two-Block Retainer, which is fixed with a red lanyard at the anti two-block switch (described in the following pages). Then the weight shall be reattached to the boom extension anti two-block switch.



WARNING

Failure to re-position the anti two-block switch weight will prevent the overhoist system from functioning properly. No weight shall be on the main hoist anti two-block switch when the boom extension is being used.

6.2 MACHINES WITH MAIN AND AUXILIARY HOISTS

If the boom extension is not in the operating position, the by-pass plug shall be installed in the main boom junction box. The weight of the main hoist anti two-block switch shall be installed.

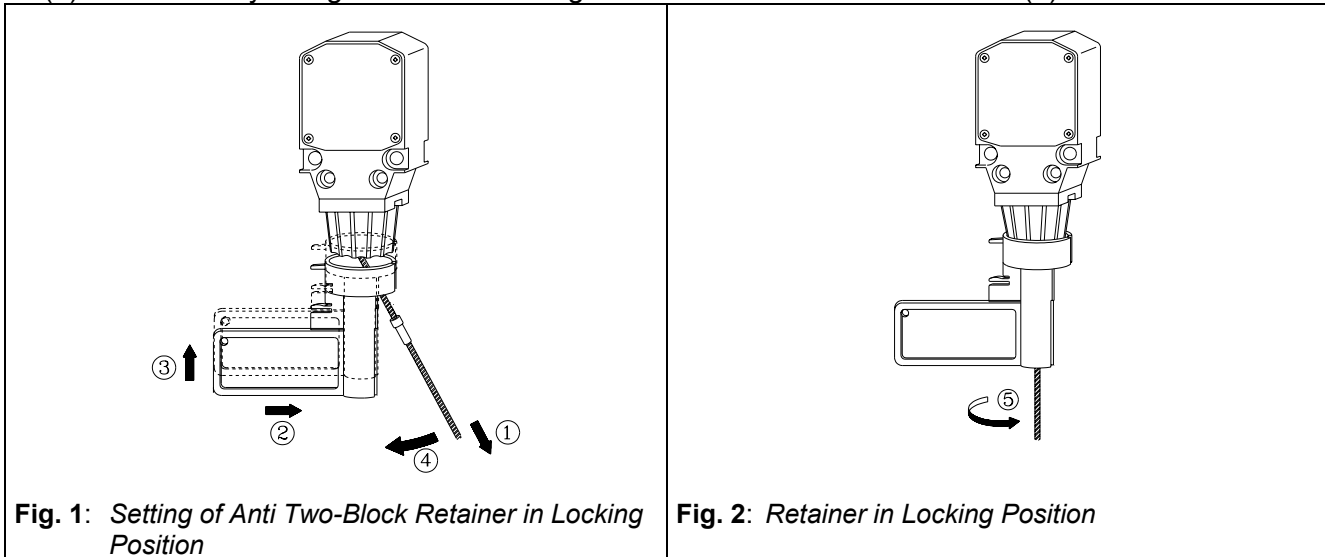
If the boom extension is in the operating position, the connecting cable shall be installed between the junction boxes on the boom extension and the main boom. Weights shall also be attached to the anti two-block switches on both the main boom and boom extension.

If the boom extension is in the operating position and no load line is being used on main boom, to prevent injury or damage to equipment, the weight shall be removed from main boom switch. In that case the anti two-block switch has to be locked with the red Anti Two-Block Retainer, which is fixed with a red lanyard (not shown) at the anti two-block switch.

6.3 ANTI TWO-BLOCK RETAINER INSTALLATION

Installation of Anti Two-Block Retainer in Locking Position Procedure (see Fig. 1 and 2):

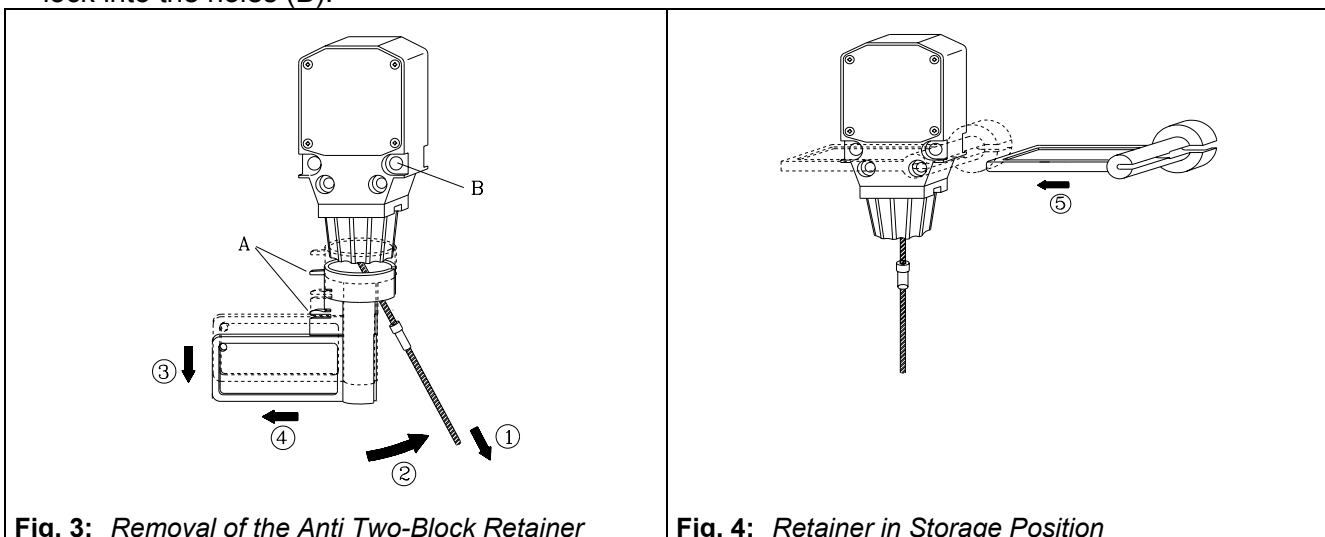
1. Pull the cable out of the switch and bend back parallel to the boom and hold (1).
2. Slide the retainer from left side with its slot over the cable between the crimped stop and the switch (2). Push it firmly straight onto the cable guide of the Anti Two-Block switch (3).



3. Straighten the cable completely into the slot and release the cable (4).
4. Turn the flag of the retainer for best visibility for the operator (5).

Removal and Storage of the Anti Two-Block Retainer Procedure (see Fig. 3 and 4):

1. Pull the cable out of the switch (1) and bend back parallel to the boom and hold (2).
2. Move the retainer down (3) and then left (4) to remove it from the Anti Two-Block switch. Release the cable.
3. For storage slide the retainer from right side (5) over the Anti Two-Block switch until the clips (A) lock into the holes (B).



7 OPERATION

Upon correct inspection the LMI is operational. The operator shall be thoroughly familiar with all controls of the LMI before operating the crane. The proper function of the system shall be checked by lifting a load of known weight and comparing the load to the information displayed on the LMI.

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.



WARNING

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 or re-verification of the crane's LMI calibration.

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

8 SERVICE AND MAINTENANCE

Daily maintenance of the Load Moment Indicator 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. If the insulation is worn on the electrical wiring or cable guides are damaged, these parts shall be replaced.
3. Check the anti two-block limit switches for freedom of movement.

Other than correcting the problems identified in the Malfunctions Table and replacing faulty mechanical parts and cables, no other repairs shall be performed by non-expert personnel.

When the LMI system is turned on, it will go through a self-test. During this time, the console must display the following screen:



Make sure the display is working and all the lights come on during this time. Listen to the buzzer sound. If any of the components above fails, please contact you're nearest service representative before operating the system!

9 TROUBLESHOOTING

9.1 GENERAL

In case of a malfunction of the system, the display (1) will indicate a code that identifies the system malfunction.

The error codes listed in the Malfunction Table will identify various faults that can occur with the LMI. 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.

9.2 OPERATING ERRORS

Malfunctions in the system, which are caused by, range exceeding or operating errors by the crane operator himself are indicated on the display together with an explanation. These error codes are E01, E02, E03, E04, (E05) and they can normally be eliminated by the crane operator himself.

Error Code	Cause	Elimination
E01	Fallen below the minimum radius or above the angle given in the load capacity chart due to luffing up the boom too far.	Refer to Load Chart. Boom down to a radius or angle given in the load capacity chart.
E02	The maximum radius or minimum angle given in the load capacity chart was exceeded due to luffing down the boom too far.	Refer to Load Chart. Boom up to a radius or angle given in the load capacity chart.
E03	Boom position is out of the permissible working area (over front).	Move boom back to the permissible working area. See lifting diagram in the load capacity charts.
E04	Operating mode in the console incorrectly set.	Correctly set operating mode to the code assigned to the operating mode of the crane.
	Operating mode is not permissible with the actual crane configuration, boom position or area definition.	Be sure crane is set up according to proper operating configurations.
E05	Prohibited length range	Refer to Load Chart. Extend/retract boom to the correct length

9.3 ANALOG INPUT CHANNEL ERRORS

These errors occur if the input signal of an analog input channel falls below (E1x) the minimum (500mV) or exceeds (E2x) the maximum (4500mV).

The analog channels are used as follows:

Sensor	Pins Terminal X1	Lower Limit	Upper Limit
Piston Pressure Transducer	32	E12	E22
Rod Pressure Transducer	33	E13	E23
Length Sensor	34	E11	E21
Angle Sensor	35	E15	E25

Troubleshooting a Sensor Problem using the Display

For a sensor error or problem with a sensor, look at the output voltage of the pressure transducer, length, and angle sensors on the display screen and compare the reading with the following:


Pressure transducers (piston and rod), 500mV @ 0psi

Length sensor, 500mV @ retracted boom length

Angle sensor, 4500mV at 0°, 2500mV at 45°, or 500mV at 90°

Note: The sensor output voltages displayed will not be the same as measured in the central unit. Refer to DS160 troubleshooting manual, 031-300-190-142, for voltage and current measurements at the terminal strip inside the central unit.

To access the analog output screen use the following procedure.

1. From the operating screen, press and hold the information button  for 5 seconds.
2. The screen show the following selections:
 - sensor outputs
 - exit
3. Use the 'UP' and 'DOWN' arrows to high light (text flashes) sensor outputs, and then press 'OK' to display a similar screen as shown below:
4. Press the 'OK' button to exit back to operating 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.

