PAT

PAT

LOAD MOMENT INDICATOR

DS 350 / 1361 Graphic
RT875CC

OPERATOR'S MANUAL

P/N 031-300-190-137 REV E 09/03/2002

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MANUAL REVISIONS

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1 GENERAL INFORMATION

The PAT Load Moment Indicator[1] (LMI) DS 350 has been designed to provide the crane operator with essential information required to operate the machine within its design parameters.

This low temperature system uses heaters for stable system operation in a subzero climate. The main electronics are automatically warmed before the system boards and components are energized. Therefore, all system components must be installed and sealed from the environment when operating and/or troubleshooting in low temperature conditions.

Using a variety of sensing devices, the Load Moment Indicator monitors various crane functions and provides the operator with a continuous reading of the crane's capacity. The readings continuously change as the crane moves through the motions necessary to make the lift.

The LMI provides the operator with information regarding the length and angle of the boom, working radius, rated load and the calculated total weight being lifted by the crane.

If prohibited conditions are approached, the DS 350 Load Moment Indicator will warn the operator by sounding an audible alarm, lighting a warning light, and rendering inoperative those functions that may aggravate the crane's condition.

[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**

2 WARNINGS

The LMI is an operational aid that warns a crane operator of approaching overload conditions and of overhoist 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 in this manual and supplied by the crane manufacture 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.

⚠ WARNING

The anti-two block switches must be used in ALL operations. Simultaneous two-hoist working is prohibited in all circumstances.

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 manual.

⚠ WARNING

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.

3 SYSTEM DESCRIPTION

The PAT Load Moment Indicator DS 350 consists of a central micro processor unit, operating console, length/angle sensor, pressure transducers, and anti-two block switches. This low temperature system uses heaters for stable system operation in a subzero climate. The main electronics are automatically warmed before the system boards and components are energized. In low temperature conditions, a warm-up period is required.

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

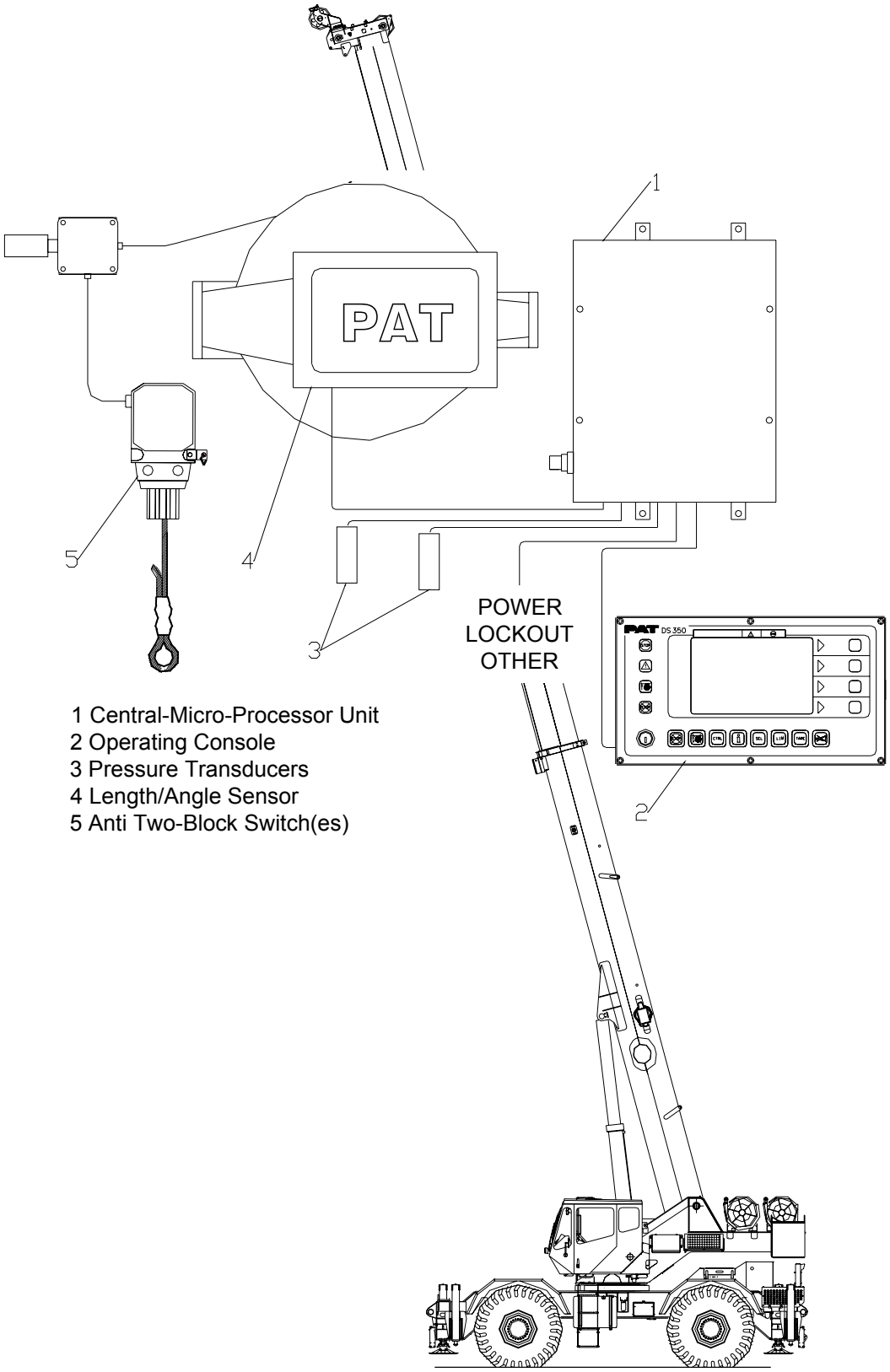
Fixed data regarding the crane, such as capacity charts, boom weights, centers of gravity and dimensions are stored in memory chips in the central processor unit. This data is the reference information used to calculate the operating conditions.

Boom length and boom angle are 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.

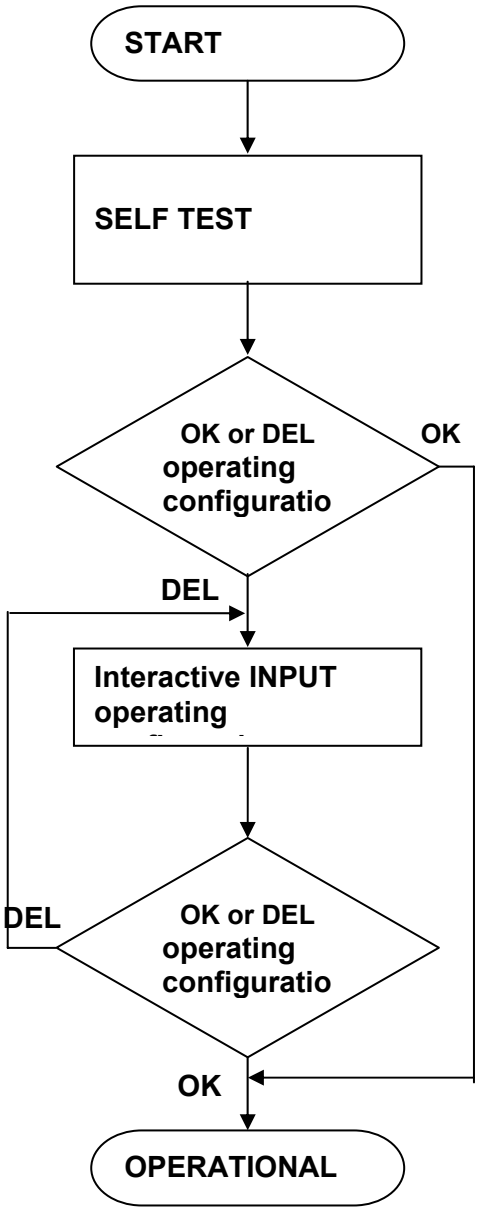
The crane load is measured by pressure transducers attached to the piston and rod side of the hoist cylinders.

The interactive user guidance considerably simplifies the input of operating modes as well as the setting of geometry limit values.

Fig. 1: **Components of the LMI system PAT DS 350**



3.1 System Function



While the system is switching on, it starts with an automatic test of the LMI system, lamps and audible alarm. During the test, the LC display shows the initial logo. Note during low temperatures the LC display will not show the graphics, or be-come operational, until the console heater has warmed the electronics.

The previous configuration setup will be displayed showing bold symbols as selected inputs and must only be confirmed OK if that configuration setup corresponds with the crane's actual configuration. Otherwise it must be deleted to enter a new configuration. (⇒ chapter 4)

The operating mode is determined by an interactive series of questions about the rigging states.

Now the LCDisplay shows in symbols all inputs and awaits verification or cancellation.

The system is ready for operation after verification of the data .

3.2 Operating Console

The console has 3 functions:

- **Inputs by the crane operator (operating mode, reeving)**
- **Input of geometry limit values and notification of exceeded limit values**
- **Display of important data and information**

The operator's console is mounted in the crane's cab in the operator's field of vision. The displays and operating elements are continuously backlit.

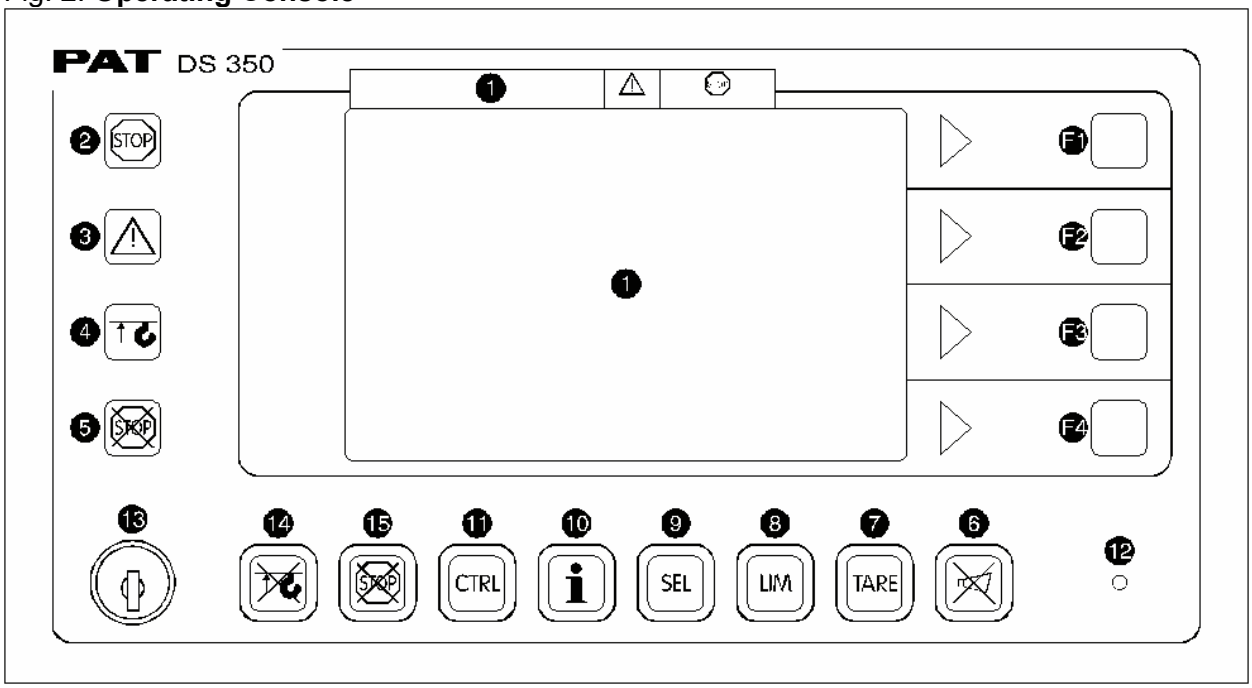
3.3 Control Identification

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

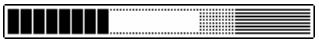
Legend to Fig 2:

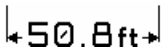
1 LC Display Area
2 Load Moment Limit Light
3 Load Moment Prewarning Light
4 Alarm Light “Anti-Two-Block”
5 Override Key Warning Light
6 Button “Alarm Stop”
7 Button and Control Light “TARE”
8 Button and Control Light “LIMITS”
9 Button and Control Light “SELECT OPERATION MODE”
10 Button and Control Light "INFO"
11 Button and Control Light "CONTROL" back light control button
12 Audible Alarm
13 By-Pass Key Switch
14 Button and Control Light "By-Pass Anti-Two-Block"
15 Button and Control Light "By-Pass LMI shut-off function"
F1 Button "Function 1"; used in configuration setup
F2 Button "Function 2"; used in configuration setup
F3 Button "Function 3"; used in configuration setup
F4 Button "Function 4"; used in configuration setup

Fig. 2: **Operating Console**



❶ LC-Display





The LCD shows graphical symbols, texts and numerical values. Depending upon the selected operating mode (setup, limit mode or LMI representation), the matching information is indicated on the display.

Please refer to specific information for selected operating mode.

The display shows a utilization bar graph below the green, yellow, and red area over the upper left portion of the display. The utilization bar graph indicates the percent load of the maximum load. The green portion of the indicates 0 to 90%, the yellow prewarning indicates 10% to over load cutout, and the red indicated over load over 100% of maximum load.

❷ Load Moment Limit Light

The red LOAD MOMENT LIMIT LIGHT (2) warns the operator that a rated load condition has been reached. When the load on thecrane reaches the crane load capacity this light comes on and the audible alarm sounds. During this condition, the following crane movements will be stopped: hoist UP, telescope OUT, boom DOWN.

❸ Load Moment Pre-warning Light

The yellow LOAD MOMENT PRE-WARNING LIGHT (3) will light up when the load on the crane reaches the defined pre-warning area, indicating that an overload condition is approaching.
The operator should continue crane operation only with extreme caution.

❹ Alarm Light “Anti-2-Block”

The red “ANTI TWO-BLOCK ALARM LIGHT” (4) 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 and the following crane movements will be stopped: hoist up, telescope out, boom down.

❺ Override Key Warning Light

The red OVERRIDE KEY WARNING LIGHT (5) flashes to indicate that the cut-off function of the A2B / LMI system is deactivated.

❻ Button and Control Light “Alarm Stop”

This ALARM STOP BUTTON (6) allows the audible alarm to be silenced for approximately 15 seconds by pressing this button. Reference ⇨ “Audible Alarm” (12).

❼ Button and Control Light “Tare”

The button “TARE” (7) is used to indicate the “Net load” on the LC Display (1). Net load is the present load, less lifting tackle and hook block. The Tare Button (7) must be activated before lifting.

After pushing the “Tare Button” (7) 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).

❽ Button "LIMITS"

Button to start the function "program limit values".
Please refer to Section 5.1 for the setup procedure.

❾ Button "SELECT"

Button to start the function "set operating mode".
For the proceeding please refer to Section 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.

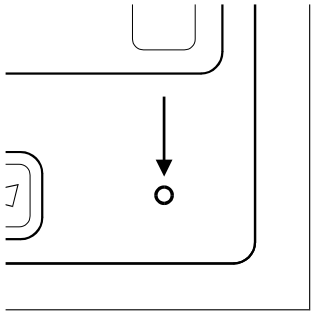
❿ Button "INFO"

Button to start the function "information crane configuration"
Please refer to Section 5.2.

⓫ **Button "CONTROL"**

Button to start additional functions.
Please refer to Section 5.3.

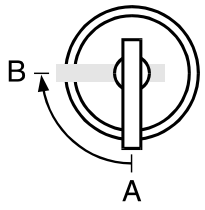
⓬ Audible Alarm



The AUDIBLE ALARM (12), sounds during the following conditions:

overload condition
approaching two-block condition
preset limits reached
malfunction of the LMI system
operating error
The alarm can be temporarily silenced by pushing the button "Alarm Stop" (6).

⓭ Key Switch



The anti-two-block switch cut-off function is deactivated when the KEY SWITCH (13) is turned to position "B" and the "By-pass A2B" button (14) is pushed.
OR
The LMI cut-off function is deactivated when the KEY SWITCH (13) is turned to position "B" and the "By-pass LMI" button (15) is pushed

⚠ WARNING

Since button (14) and (15) deactivate the cut-off 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.**

⓮ Button "By-pass A2B"

This button can be operated only if key switch (13) is turned to position B.
After pushing this button, the cut-off function of the anti-two-block switch is deactivated.
The Override Key Warning Light (5) flashes to indicate that the cut-off function is deactivated.

⓯ Button "By-pass LMI"

This button can be operated only if key switch (13) is turned to position B.
After pushing this button, the control lever lockout function of the LMI is deactivated.
The Override Key Warning Light (5) flashes to indicate that the cut-off function is deactivated.

4 CONFIGURATION SETUP

The LMI setup procedure allows the operator to input the crane configuration using interactive displays. The operator must complete the setup procedure for the Load Moment Indicator system if the system has been turned off for more than two hours or the crane operation configuration has been changed.

4.1 LMI Setup Procedure

...starts: ***automatically*****, if the system was turned off for more than two hours.**
manually **at each modification of the crane configuration by pressing key (9) "SEL"**

...is operated: **by answering the different questions using functional keys F1...F4 matching the actual configuration of the crane.**

...is cancelled: **any time by pressing again key (9) "SEL". The system, however, is only ready for operation, if the procedure has been completed and the inputs have been confirmed.**

If the system is turned off less than 2 hours (during short breaks), all adjustments remain stored. When turning the system on again, these adjustments can be acknowledged by merely pressing the "OK" function key *if* the crane configuration has not been modified. Note during low temperatures the LC display will not show the graphics, or become operational, until the console heater has warmed the electronics.

For extended travel on tire without load, Press the "SEL" button to silence the alarm. NOTE: When the "SEL" button is pressed and no operating configuration is selected, the boom down and tele out functions are locked out because the LMI is not in operation.

During the programming procedure the Load Moment Prewarning Light (3) and the Load Moment Limit Light (2) will light up and the aggravating crane movements 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!

⚠ CAUTION

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;Note:
The main boom and counterweight configuration are automatically setup. This system is not set up for use with an extension or additional counterweight.

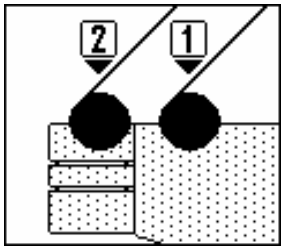
setting the hoist configuration
setting the outrigger configuration
setting the reevings
confirmation of the programming procedure

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

Definition of the Displayed Symbols:

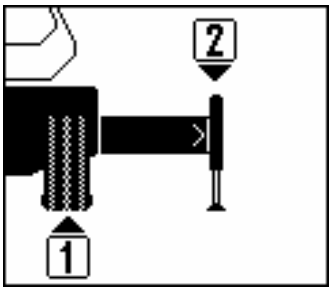
The following illustrations define the symbols appearing on the display during the setup procedure.

Setting the hoist configuration



1 **Front Hoist**
2 **Rear Hoist**

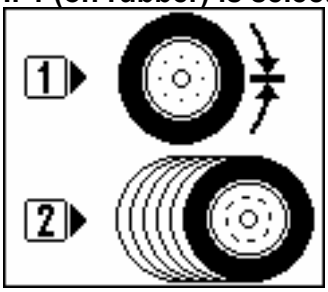
Setting the outrigger configuration



1 **on rubber**

2 **outrigger fully extended (100% position)**

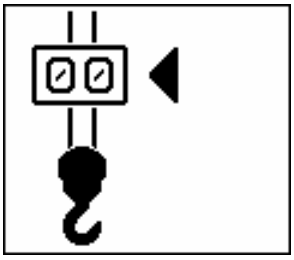
If 1 (on rubber) is selected you have the followingchoices.



1 **static**

2 **pick and carry**

Setting the reeving (parts of line)



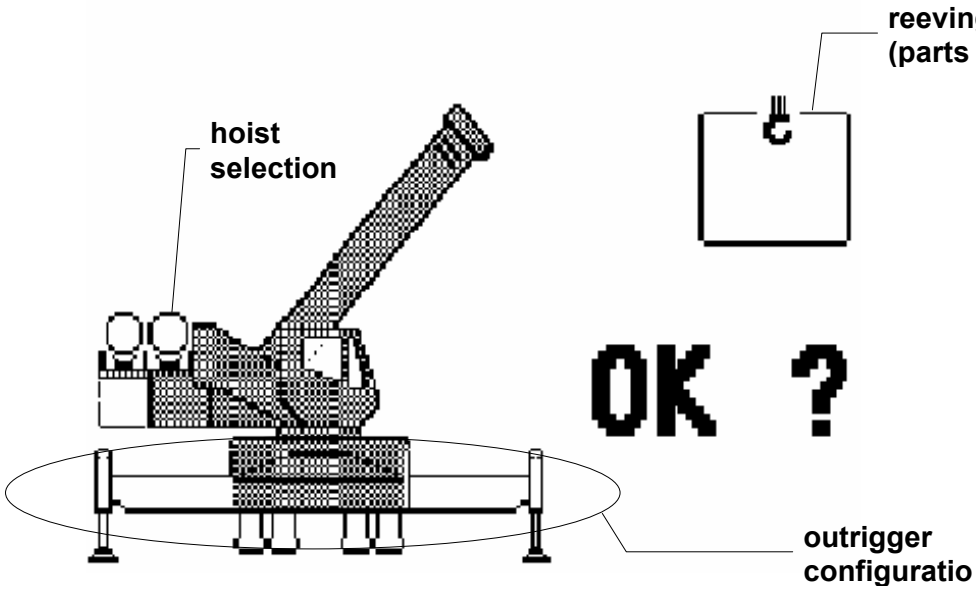
\+ **increase reeving**

– **decrease reeving**

OK **confirm reeving**

Confirmation of the programming procedure

SETUP



At the end of the procedure all inputs are represented once again in symbolic forms. If inputs have been made, the corresponding symbols are filled black.

 **quick setting the reeving (⇨ Section 4.3)**

 **quick hoist line selection (⇨ Section 4.2)**

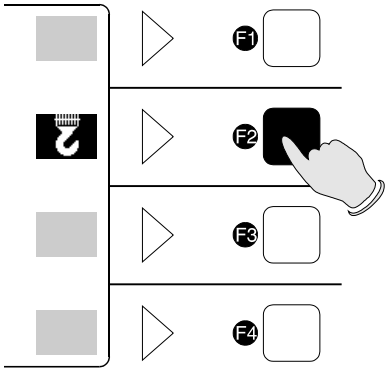
DEL **cancel procedure**

OK **confirm inputs**

4.2 Quick Setting of the Reeving

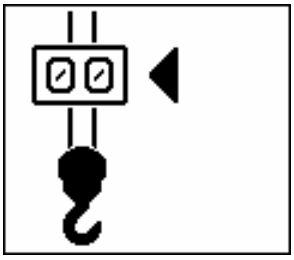
If, during the crane operation, the reeving is modified, the LMI system has to be adjusted to this modification. The input of the reeving can be carried out directly without having to go through the whole LMI programming procedure again:

Call LMI Programming Procedure.



Directly call function "Quick Setting of the Reevings".

Note:
The direct call is impossible, if the system has been turned off for more than 2 hours.

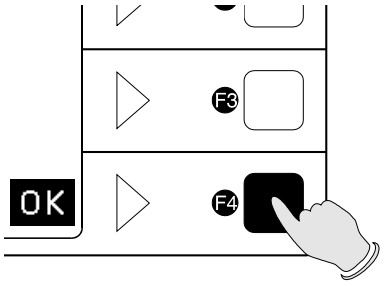


input of reeving:

+ increase reeving

– decrease reeving

OK confirm reeving



Confirm modification.

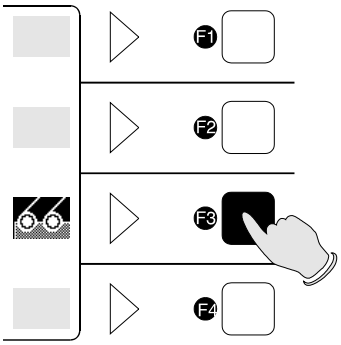
(select again the function upon faulty input)

Note:
If a configuration is selected which is not available on the present crane, the system will not accept the selection and the display will indicate the error code E04.

4.3 Quick Hoist Line Selection

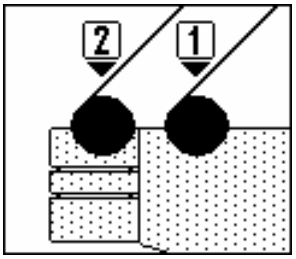
If, during the crane operation, the crane is switched over from front to rear hoist, the LMI system has to be adjusted to this modification. This modification can be entered without having to go through the whole LMI setup procedure again:

Call LMI setup procedure.



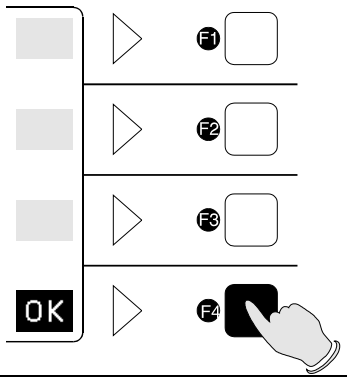
Directly call function "Hoist Line Selection".

Note:
The direct call is not possible, if the system has been turned off for more than 2 hours.



Select hoist:

1 **Front Hoist**
2 **Rear Hoist**



Confirm modification.

(call up the function again if you have selected the wrong winch by mistake)

Note:
If a configuration is selected which is not available on the crane, the system will not accept the selection and the display will indicate the error code E04.

4.4 Anti-two Block (A2B) Switch(es)

All RT875CC cranes are provided with two different configurations of A2B switches. Correct use of the A2B switches must be followed to prevent material damage and serious or even fatal accidents. The applications under which these switches are used are described below:

a. Main Boom A2B Switch

The main anti-two block switch is used in all main boom applications (movements and lifts). This switch is used in conjunction with a chain and the weight around the main hoist cable. A by-pass flag must be installed in the auxiliary boom nose A2B switch during main boom operation.

Without the flag installed crane functions will remain locked out.

b. Auxiliary Boom Nose A2B Switch

The auxiliary anti-two block switch is used in auxiliary boom nose applications (movements and lifts). This switch is used in conjunction with a chain and the weight around the auxiliary hoist cable. A by-pass flag must be installed in the main boom A2B switch during auxiliary boom nose operation.

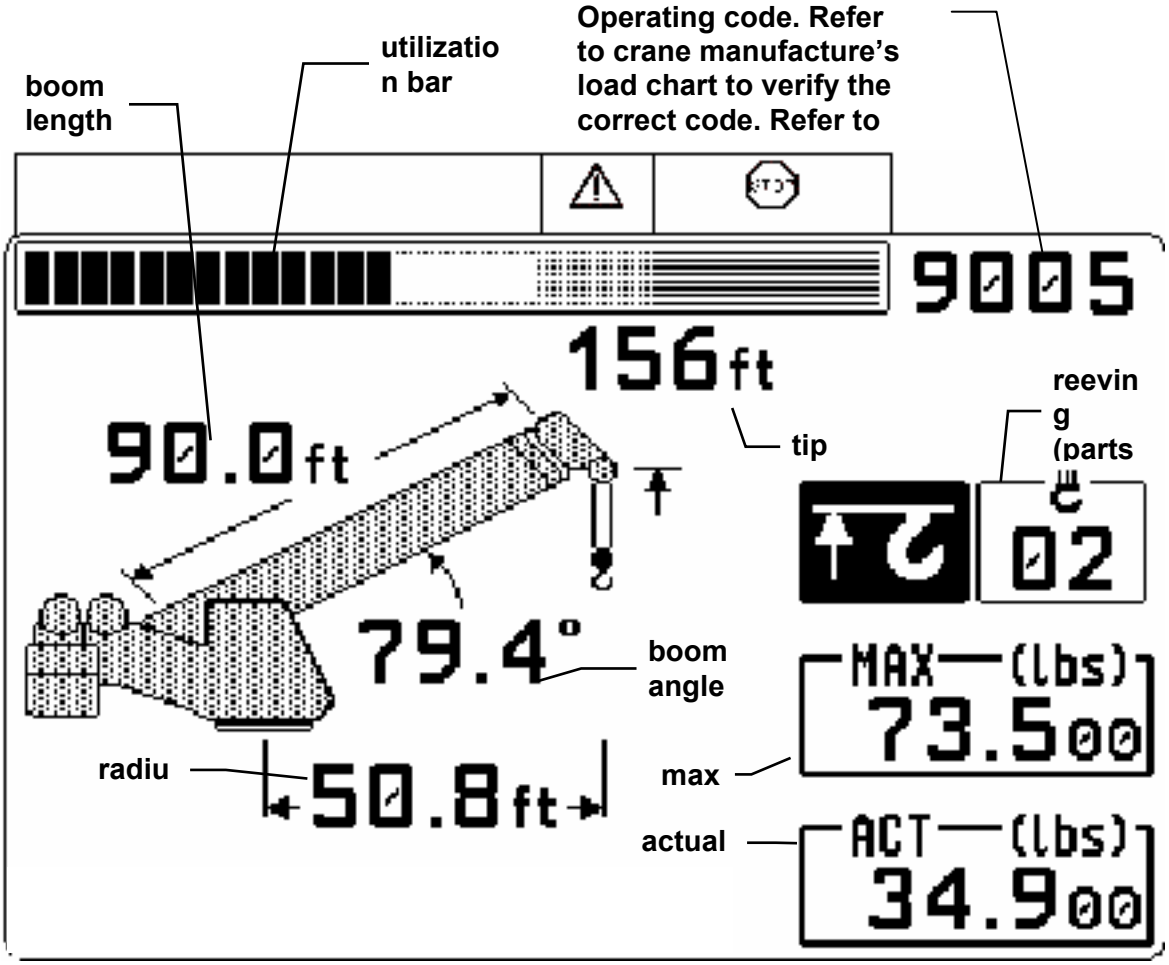
Without the flag installed crane functions will remain locked out.

⚠ WARNING

The anti-two block switch must be used in ALL Operations. Simultaneous two-hoist working is prohibited in all circumstances.

5 OPERATION

After having set the LMI to the actual crane configuration, the system is ready for operation. The display shows the LMI screen (example for value representation).



Before commencing operation, verify that the operating code appearing on the LMI screen corresponds exactly to the applicable LMI operating code appearing in the specific capacity chart being used.

Note 1: The operating code shown 9005 is the default operating code with least allowable lifting capacity. The defult selection allows quick configuration setup when moving the crane.

Note 2: During normal operation the load display will blank out below 3000lbs

When the system condition is activated, the following symbols will be displayed.

Symbol Anti Two-Block Alarm
visible when the anti-two-block limit switch contacts open, indicating that a two-blocking condition is approaching.

Symbol height limitation:
continuously visible: height limitation active
blinking:
height limit exceeded
(⇨ see Section 5.1.2)

Symbol boom angle limitation:
continuously visible:
boom angle limitation active
blinking:
angle limits exceeded
(⇨ see Section 5.1.3)

Symbol radius limitation
continuously visible:
radius limitation active
blinking:
range limits exceeded
(⇨ see Section 5.1.4)

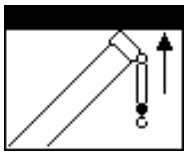
E#### **Error code No. ####**
(⇨ see Section 8 "Troubleshooting")

5.1 LIMIT Setting

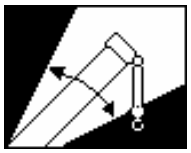
The LMI system has been equipped with programmable limits for the crane's operation range.

Easy programming due to interactive, step-by-step user guidance
Functions can be used individually or in combinations.
Exceeding a programmed limit triggers an audible and visual alarm.

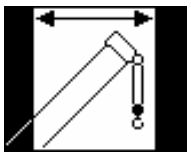
Overview limits:



Tip Height Limitation
(⇨ Section 5.1.1)



Boom Angle Limitation
(⇨ Section 5.1.2)

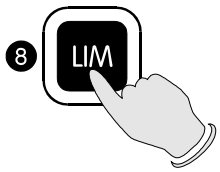


Radius Limitation
(⇨ Section 5.1.3)

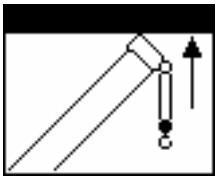
5.1.1 Tip Height Limitation

Programmable function for the limitation of the tip height

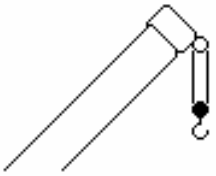
Set tip height / delete height limitation:



Call LIMIT Setting.

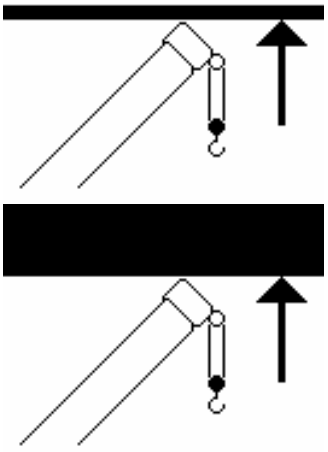


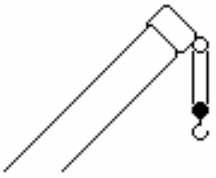
Press the corresponding figure to select function "tip height limitation".



Press key

set:	delete:
Move the tip to the required upper limit.	**DEL delete tip height limitation**
SET set present tip height as upper limit	
Display shows symbol and value of the programmed height limit	
	Display shows symbol without values



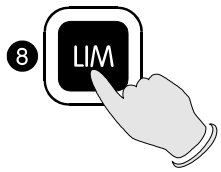


OK quit function

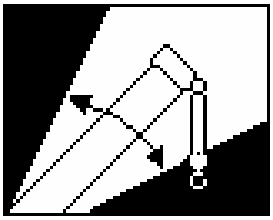
5.1.2 Boom Angle Limitation

Programmable function for the limitation of the upper and/or lower boom angle.

Call function:

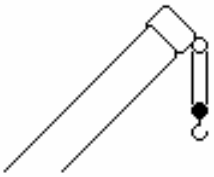


Call LIMIT Setting.



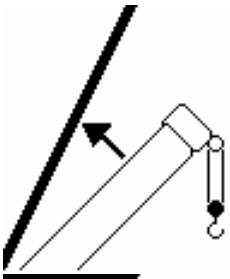
Enter the corresponding figure to call function "boom angle limitation".

set / delete upper limit value:

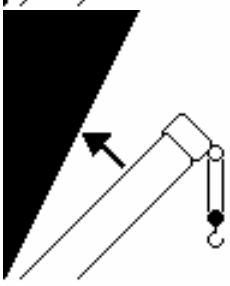


Select limit:

selection upper boom angle limit

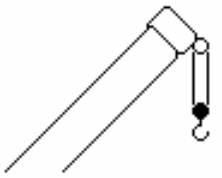


set:	**delete:**
Luff up the boom the requested limit value.	**DEL delete upper angle limit**
SET set present boom angle as upper limit	
Display shows symbol with value of the upper angle limit	**Display shows symbol without value of the upper angle limit**



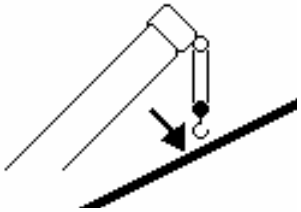
OK quit function

set / delete lower limit angle

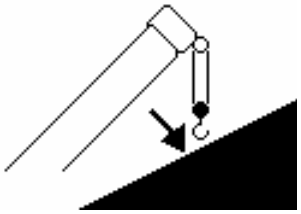


Select limit:

 **selection lower boom angle limit**



set:	**delete:**
Luff down boom to the required limit value.	DEL **delete lower angle limit**
SET **set present boom angle as lower limit**	
Display shows symbol with lower angle limit	**Display shows symbol without value of lower limit angle**

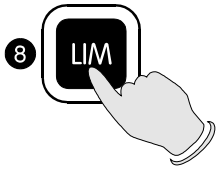


OK **quit function**

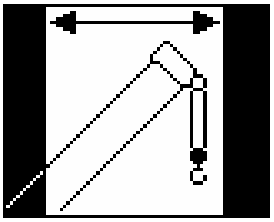
5.1.3 Radius Limitation

Programmable function for the limitation of the minimum and/or maximum working radius.

Call function:

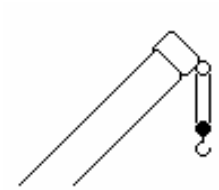


Call LIMIT Setting



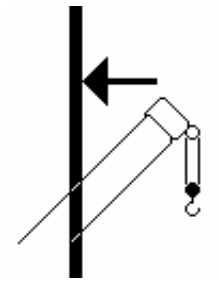
Select the corresponding figure to call the function "radius limitation".

set / delete minimum radius:

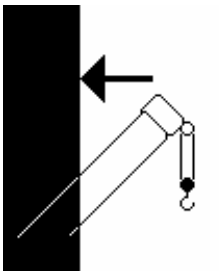


Select limits:

select minimum radius limit



set:	delete:
position boom at the required minimum radius value.	DEL delete minimum radius limit
SET set present boom radius as minimum radius	

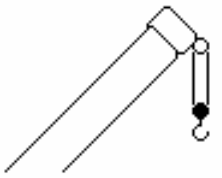


display shows symbol with radius value of minimum limit

display shows symbol without value of minimum radius

OK quit function

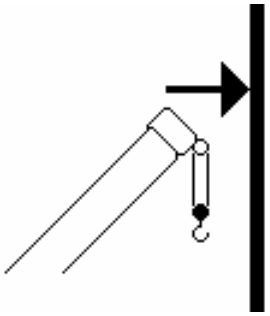
set / delete maximum radius

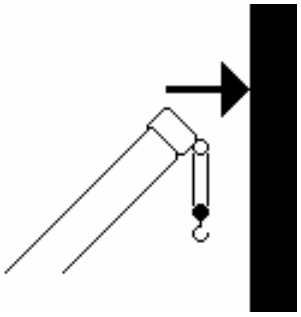


Select limit:

→| **selection maximum radius limit**

set:	**delete:**
position boom to the required maximum radius value.	**DEL delete maximum radius limit**
SET set present boom radius as maximum radius	
display shows symbol with radius value of max. limit	**display shows symbol without value of max. radius**



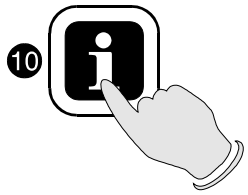


OK quit function

5.2 INFO crane configuration

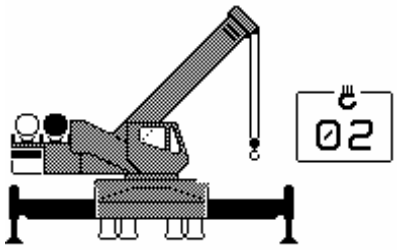
With the system being ready for operation, this function serves to display the system configuration

Call function



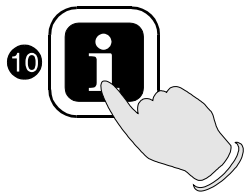
Press key "INFO".

INFO



The display shows the crane symbol representing the adjusted configuration (marked black), the extended operating code number and the reeving number (parts of line).

End function

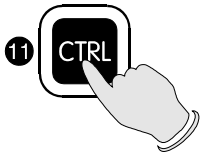


Press again key "INFO".

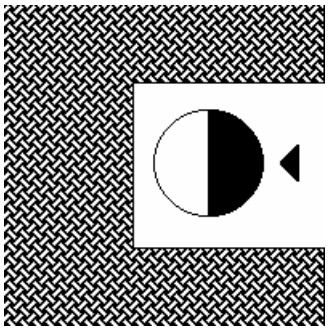
5.3 Display Contrast Control

This function serves for the contrast adjustment of the LC display. The last adjustment is stored and does not have to be repeated at every system start.

Contrast adjustment



Press "CTRL".



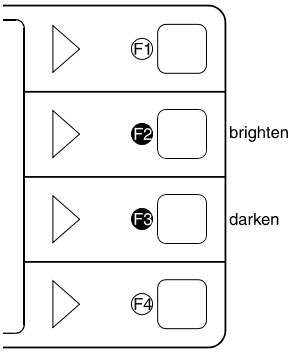
A pattern is shown by means of which the display can be adjusted to the optimum contrast. Use the functional keys to modify the contrast upon request:

+ darken display

– brighten display

OK confirm setting

Press key "OK" to store the adjusted contrast value and to quit the function.



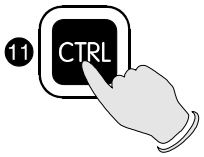
During normal LMI operation the display contrast can be adjusted too by pressing button:

F2 (brighten display) or
F3 (darken display).

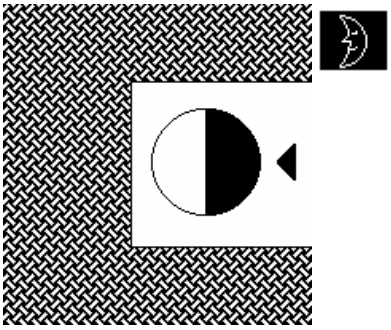
5.4 Display Dimmer

This function enables the LCD illumination to be dimmed for better visibility during night operations . During the initial power up of the console, the LCD default position is bright. Using the function key below toggle between the two positions bright and dim LCD illumination.

LCD illumination adjustment



Press "CTRL" to select the contrast adjustment mode.

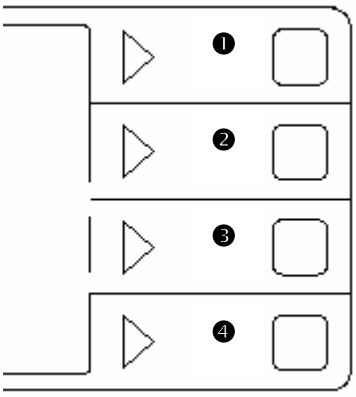


While in contrast adjustment mode, use the function key 1 to toggle between the two conditions,

brighten LCD illumination and

dim LCD illumination.

Press function key 4 (OK) to exit the LCD illumination adjustment and return to the previously selected screen.



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.

Check that the weight of the anti two-block switch is properly installed on the main hoist load line. The hoist line runs through the A2B weight. With even parts of hoisting line, the weight must be attached to the dead-end line. With odd parts of hoisting line, the weight is attached to the line of lowest speed.

After the electrical connections have been checked to ensure that the system is properly connected for the crane configuration, the following checks must be made:

Check the electrical wiring connecting the various parts of the system for physical damage.
Check the anti two-block switch and weight for free movement.
Check the spring-loaded cable reel to be sure it is free to rotate, has tension and the cable is reeled properly.

⚠ 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.

If the operator cannot see the load handling device approaching the boom nose, an assistant (signal person) must watch the load handling device. The operator shall be prepared to stop the machine immediately should the LMI system not function properly as indicated by lighting the red warning light (4), sounding the audible alarm (12) and locking the crane movements, hoist up, telescope out and boom down. (See page 6 for location of these components on the display)

1. **Check the anti two-block alarm light (4) and the audible alarm (12) by performing one of the following tests:**

   - **By manually lifting the weight attached to the anti two-block switches. When the weight is lifted, the audible alarm (12) should sound, the anti two-block alarm light (4) should light.**
   - **Slowly raise the main boom load handling device to create a potential two-block condition. When the load handling device lifts the weight, the audible alarm (12) should sound, the anti two- block alarm light (4) should light and the motion of the load handling device should be stopped. Lower the load handling device slightly to eliminate this condition.**
   - **Slowly lower the boom to create a potential two-block condition. When the load handling device lifts the weight, the audible alarm (17) should sound, the anti two-block alarm light (24) should light and the boom lowering function should be stopped. Lower the load handling device slightly to eliminate this condition.**
   - **Slowly extend (telescope) the boom to create a potential two-block condition. When the load handling device lifts the weight, the audible alarm (17) should sound, the anti two-block alarm light (24) should light and the boom telescope out function should be stopped. Lower the load handling device slightly to eliminate this condition.**

⚠ WARNING

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 shall be corrected before operating the crane.

Check that the display of the main boom length agrees with the actual boom length.
Check that the display of the main boom angle agrees with the actual boom angles.
Check that the display of the operating radius of the crane agrees with the actual radius.
Check the load display by lifting a load of known weight.

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.

⚠ 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 verification of the crane's LMI calibration.

⚠ WARNING

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

7 SERVICE AND MAINTENANCE

Daily maintenance of the load moment indicator consists of inspecting:

The electrical wiring connecting the various parts of the system.
If electrical wiring is damaged, it shall be replaced immediately.

If the insulation is worn on the length sensor cable or cable guides are damaged, these parts shall be replaced.

Check the anti two-block limit switches for freedom of movement.

The cable reel shall be under tension to operate properly.

Check the pressure transducers at the hoist cylinder(s) and the connecting hoses for oil leakage.

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

8 ERROR CODES

ERROR CODE	ERROR	CAUSE	ACTION (Refer to Service Manual for detailed Action)
E01	Minimum radius or maximum angle range exceeded	Fallen below the minimum radius or above the angle given in the load chart due to raising the boom to far.	Lower boom back to a radius or angle given in the load chart.
E02	Maximum radius or minimum angle range exceeded	The maximum radius or minimum angle given in the load chart was exceeded due to lowering the boom too far.	Raise boom back to a radius or angle given in the load chart.
E04	Operating mode not available	Operating mode switch in the console set incorrectly. Operating mode is not permissible with actual crane configuration.	Set operating mode switch correctly to the code assigned to the operating mode of the crane.
E05	Length range not permitted	Boom has been extended too far or not far enough. Length sensor adjustment changed; i.e. length sensor cable slid off the cable drum.	Retract or extend boom to correct length given in the load chart. See Section 6.
E07	No acknowledgment signal from overload relay.	Overload relay is defective or not being selected.	Replace terminal board.
E08	No acknowledgment signal from Anti-Two-Block switch relay .	Anti-Two-Block switch relay is defective or not being selected.	Replace terminal board
E11	Fallen below limit for the analog channel “length”.	a.) Cable between length sensor and central unit defective, not connected or water in the connectors. b.)Length sensor Potentiometer defective. c.)Electronic component on analog input module defective.	a.)Check cable and connector and replace, if necessary. b.)Replace and reset length sensor Potentiometer. c.)Replace analog input module and reset pressure channels.

8. ERROR CODES - continued

ERROR CODE	ERROR	CAUSE	ACTION
E12	Fallen below lower limit value for the analog channel "pressure transducer piston side".	a.) Cable leading from the central unit to the pressure transducer defective, loose or water in the connector. b.)Pressure transducer on piston side defective. c.)Electronic component on the analog input module defective.	a.)Check cable and connector and replace, if necessary. b.)Replace pressure transducer and reset pressure channel. c.)Replace analog input module and reset pressure channels.
E13	Fallen below lower limit value for the analog channel "pressure transducer rod side".	a.)Cable leading from the central unit to the pressure transducer defective, loose or water in the connector. b.)Pressure transducer on rod side defective. c.)Electronic component on the analog input module defective.	a.)Check cable and connectors and replace, if necessary. b.)Replace pressure transducer and reset pressure channel. c.)Replace analog input module and reset pressure channels.
E 15	Fallen below lower limit value for the analog channel "angle main boom".	a.)Cable from central unit to the length/angle sensor defective or loose. b.)Angle sensor defective. c.)Electronic component on the analog input module defective.	a.)Check cable. Replace if necessary. b.)Replace angle sensor and reset mechanical adjustment. c.)Replace main board and reset pressure channels.

8. ERROR CODES - continued

ERROR CODE	ERROR	CAUSE	ACTION
E19	Error in the reference voltage.	Electronic component on the main board defective.	Replace main board and reset pressure channels. See Drawing 3 & Procedure 4.
E20	No analog voltages	a.)The crane supply voltage is too low. b.)The voltage converter is defective or short circuit in the wiring.	a.)Check crane voltage. b.)Check supply voltages.
E21	Upper limiting value for the measuring channel “length” exceeded.	a.)Cable from central unit to the length/angle sensor defective or loose. b.)Length potentiometer defective. c.)Electronic component in the measuring channel defective on main board.	a.)Check cable. Replace if necessary. See section 6. b.)Replace and reset length potentiometer. See Procedure 5. c.)Replace main board and reset pressure channels. See Drawing 3 & Procedure 4.
E22	Upper limiting value for the measuring channel “pressure piston side” exceeded.	a.)Cable from central unit to the pressure transducer defective, loose or water in the plug. b.)Pressure transducer on piston side defective. c.)Electronic component in the measuring channel defective on main board.	a.)Check cable as well as plug. Replace if necessary. See Section 7. b.)Replace pressure transducer and reset pressure channels. See Section 7. c.)Replace main board and reset pressure channels. See Drawing 3 & Procedure 4.
E23	Upper limit value for the measuring channel “pressure transducer rod side” exceeded.	a.) Cable lead in from the central unit to press trans defective, not connected or water in the connectors. b.) Pressure transducer on road side defective. c.) Electronic component in the measuring channel defective.	a.)Check cable and connectors as well and replace, if necessary. See Section 7. b.)Replace pressure transducer c.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4.

8. ERROR CODES - continued

ERROR CODE	ERROR	CAUSE	ACTION
E25	Upper limit value for the measuring channel "angle main boom" exceeded.	a.) Cable leading from the central unit to the length/angle sensor defective, loose or water l the connectors. b.) Angle sensor defective c.) Electronic component in the measuring channel defective.	a.) Check cable as well as connectors and replace, if necessary. Section 6. b.) Replace angle sensor and reset adjustment. See Section No. 6 & Procedure 5. c.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4.
E27	Upper limit value for the measuring channel 7 exceeded.	a.) Cable leading from the central unit to the sensor of channel 7 defective, loose or water in the connectors. b.) Sensor of channel 7 defective. c.) Electronic component in the measuring channel 7 defective.	a.) Check cable as well as connectors and replace, if necessary. b.) Replace sensor of channel 7 and reset adjustment. c.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4.
E29	Reference voltage defective.	a.) The total of the supply and the reference voltages on MP10 is more than 3.3V b.) A/D converter defective.	a.) Check supply voltages. b.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4.

8. ERROR CODES - continued

ERROR CODE	ERROR	CAUSE	ACTION
E31	Error in the system program.	a.) EPROM with system program defective. b.) Electronic component on the main board defective.	a.) Replace system program EPROM b.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4.
E37	Error in the program run	a.) EPROM with system program defective. b.) Electronic component on the main board defective.	a.) Replace system program EPROM. b.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4.
E38	Wrong system program in the LMI.	The system program in the LMI does not correspond to the programming in the data EPROM	Replace system program EPROM
E41	Error in the external RAM.	Defective electronic component.	Replace main board or analog input module. Refer to Drawing 4 and Procedure 3, Steps 1,2,4, 11, and 12.
E 42	Error in the external write/read memory (RAM).	Internal defect in digital part of CPU.	Exchange write/read memory (CMOS-RAM). Replace main board and reset pressure channels. See Drawing 3 & Procedure 4.
E45	Redundancy error in A/D conversion.	Defective electronic component.	Replace analog input module. Refer to Drawing 4 and Procedure 3, Steps 1,2,4, 11,12.
E 45	Error in internal communications.	Defective electronic component.	Replace main board and reset pressure channels. See Drawing 3 & Procedure 4.
E48	Cyclic RAM test: Error in the internal write/read memory.	Internal defect in digital part of CPU	Replace CPU module. Refer to Drawing 4 and Procedure 3 Steps 1-3, 13,14
E 51	Error in data memory.	Data EPROM on the main board defective.	Replace Data EPROM. Make sure BR3 on the main board is installed. See Theory 1.
E71	Incorrect acknowledgment of the 1. Relay on the	a.) Anti Two-block relay is stuck or defective. b.) Anti Two-Block relay is	a.) Replace 1. relay. b.) Check terminal board

	terminal board A101.	not being selected due to a break on the terminal board A101, main board or ribbon cables.	A101, main board and ribbon cables as well as replace defective part, if necessary.
E72 - E77	Analogous to E71 for the relays 2...7.	Analogous to E71 for the relays 2...7.	Analogous to E71 for the relays 2..7.

8. ERROR CODES - continued

ERROR CODE	ERROR	CAUSE	ACTION
E89	Change of the operating code during lifting a load.	The operating mode switch in the console was used during lifting a load.	Lower the load and set the operating mode switch correctly to the code assigned to the actual operating mode of the crane.
E 91	No data transmission from console to central unit. (See Section 8)	a.)24V supply of console interrupted. b.)Interruption or accidental ground in the line from console electronics to central unit. c.)Transmitter/receiver module defective.	a.)Check 24V at terminal X1 of console electronics. b.)Check the connection between console electronics and central unit. c.)If you find an accidental ground, the transmitter module in the console electronics can be damaged. You should, therefore, replace the console electronics. Replace console electronics or main board respectively. See Procedure 3
E92	Error in the data transmission from console to central unit. (See also Section 8)	a.) Temporary interruption of the data line from console electronics to central unit. b.) Transmitter/receiver module defective.	a.) Check the connection between console electronics and central unit.
E93	Error in the data transmission from central unit to console. (See also Section 8)	a.) Temporary interruption of the data line from console electronics to central unit. b.) Transmitter/receiver module defective.	a.) Check the connection between console electronics and central unit. b.) Replace console electronics or main board respectively. See Procedure 3

8. ERROR CODES - continued

ERROR CODE	ERROR	CAUSE	ACTION
E94	No data transmission from central unit to console. (See also Section 8)	a.) Interruption or accidental ground in the line from console electronics to central unit. b.) Transmitter/receiver module defective. c.) Data-EPROM defective. d.) CPU defective. e.) Electromagnetic interference (when switching contractors or valves)	a.) Check the connection between console electronics and central unit. If you find an accidental ground, the transmitter module in the console electronics can be damaged. Replace the console electronics. b.) Replace console electronics or main board respectively. c.)Check data EPROM. d.) Replace main board. e.) Eliminate interference source by inverse diodes or resistors.
E95	Error in the crane data EPROM	a.) Data EPROM defective b.) Position of jumper for the selection of the type of EPROM is wrong c.) Electronics component on the main board defective.	a.) Replace data EPROM b.) Check the jumper position c.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4.
E96	Error in the internal RAM of the CPU of the console	CPU or main board of the console defective	Replace console main board.
E97	Error in the external RAM of the CPU of the console	a.) External RAM of the console defective b.) Electronic component on the main board defective.	a.) Replace console main board b.) Replace console main board
E98	Wrong jumper position in the console	a.) The jumper position BR 9/BR 10 in the console does not correspond to the actual type of central unit. b.) Electronic component on the main board defective.	a.) Check the jumper position b.) Replace console main board