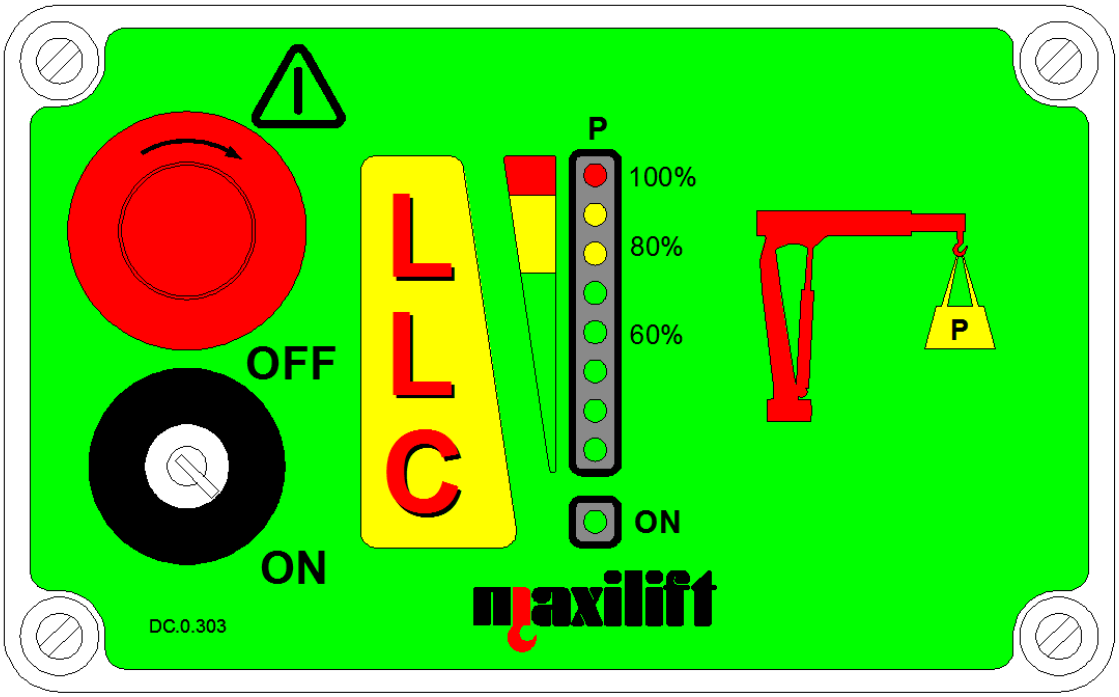
Load limiting cell

LLC



Installation Manual
(Part 3 of 4)

Rev. 1
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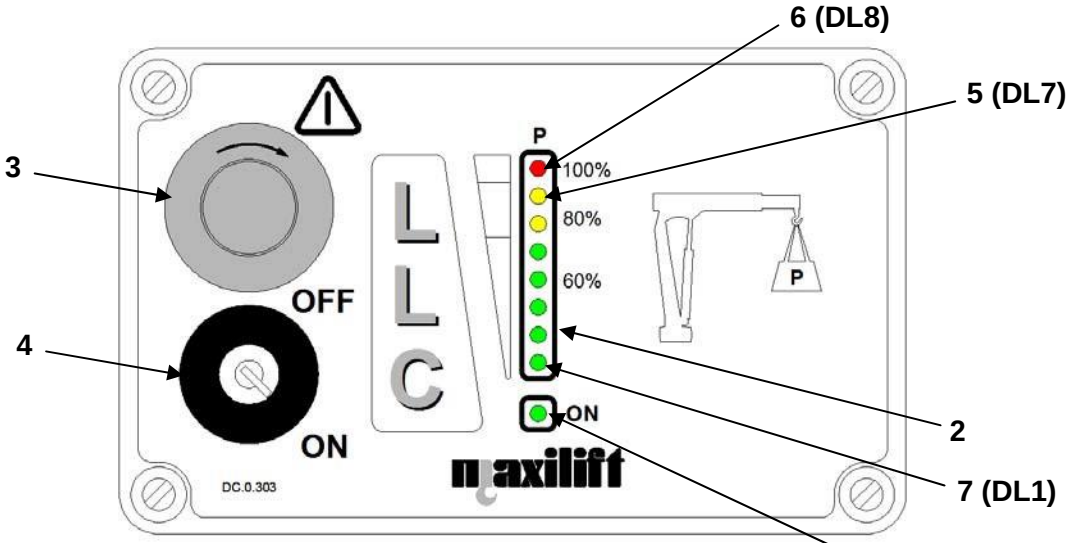
Load Limiting Cell LLC – Operation & Maintenance Manual

1 Functioning

The LLC system is a locking device for the lifted load, with limitation to 990 kg, and an indicating device for the rated capacity by means of a LEDs scale (2). The system intervenes and locks the crane functions, when the load applied to the hook, sensed by a load cell placed on the hook attachment, reaches the setting value of 990 kg, which is the maximum lifting capacity for the "LC" version. In this condition, all the LEDs from DL1 to DL8 flash, and it's not possible to carry out any manoeuver except for the boom lowering. Further, the device displays the level of the allowed rated capacity. The lower green LED (ON), separate from the others, indicates that the system is live. Five further green LEDs (60%) indicate per cent rates from 30% to 70% of the maximum rated capacity allowed, the two yellow LEDs (80%) indicate 80% and 90%, while the red LED (100%) shows that the maximum rated capacity allowed for the crane has been reached or exceeded. ***The operator shall prevent lighting up of the red LED (overload) while using the crane.***



Pict. 1

1.1 Components and external signals for the operator

1) green LED "**ON**" (DL0), when lit up, indicates that the system and the crane are supplied, by means of the key switch (**4)**
2) LEDs scale
3) the emergency stop button locks immediately all the crane functions
4) the key switch allows the supply to the system and the crane
5) yellow LED 90% (DL7)
6) red LED 100% (DL8)
7) green LED (DL1)

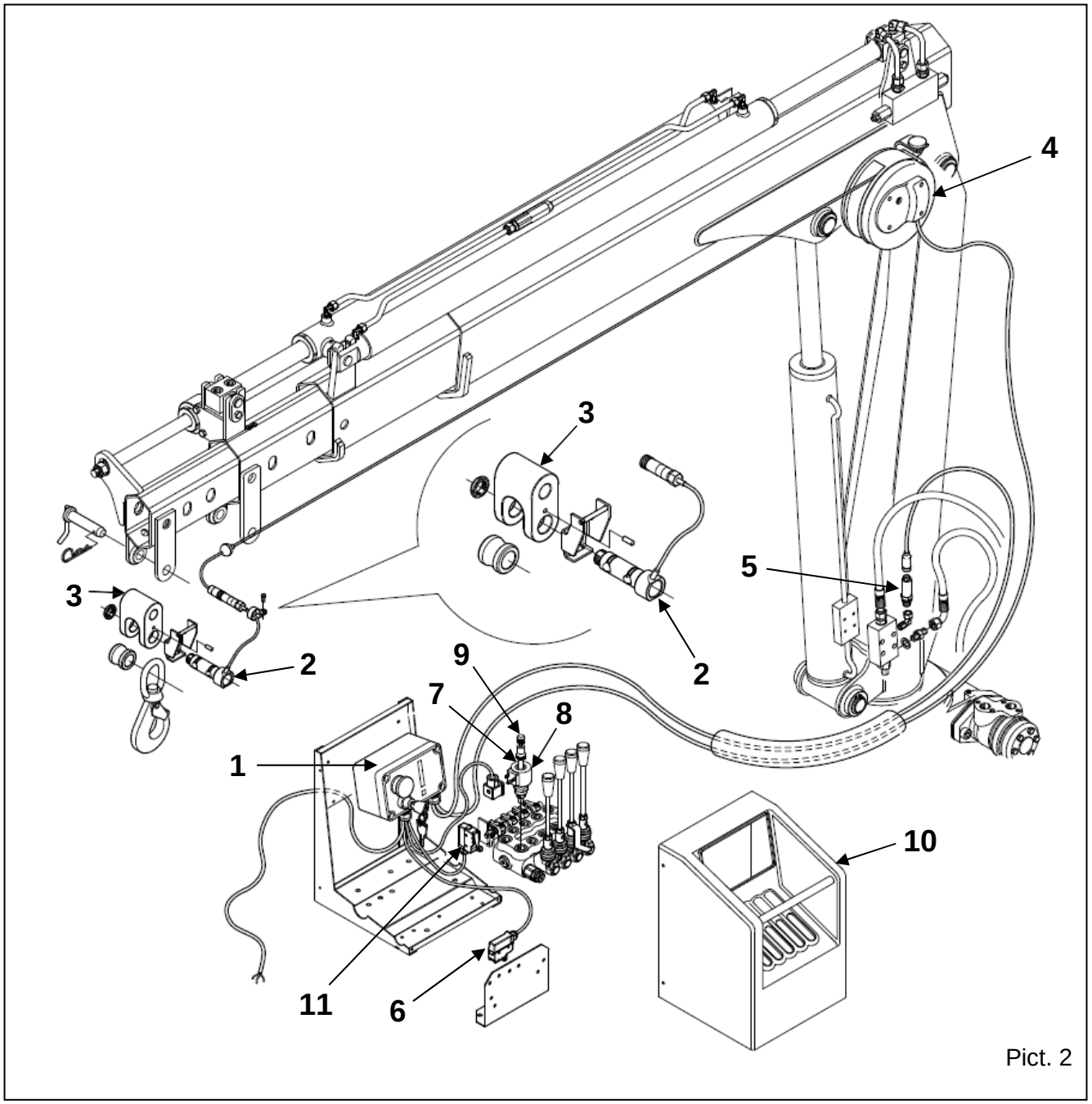
The LEDs also provide information on the status of the system, signalling any faults, listed in the following table.

LED	Status	Reported situation
DL1	Flashing	Signal from load cell too low (* see 5.4.1)
DL7	Flashing	Signal from load cell over the permitted range, or cable from the load cell interrupted or in short circuit (see 5.4.3)
DL8	Flashing	Signal from pressure transducer over the permitted range, or cable from pressure transducer interrupted or in short circuit (see 5.4.2)

DL1 ÷ DL8	Flashing simultaneously	Overload load cell
DL8	Lit up	Calibration not correct (see chapter 3)

2 Components overview

2.1 Components description (Pict. 2)



Pict. 2

2.1.1 Control unit box (1)

It is placed on the control station, and contains the electronic card that processes the signals coming from all the input/output devices it is connected with. The front panel carries the keyswitch and the emergency stop button and allows the visualization of the signals from the electronic card.

2.1.2 Load cell pin (2)

It is a special pin with a load cell built in, provided with a short connection cable. The load cell pin holds the hook, and it is fitted in the lower side of a support (**3**), which is fitted, in turn, to the attachment on the last extension beam. The load cell senses the load applied to the hook. Its output is a variable electric signal, proportional to the lifted load. The signal is transmitted through a cable reel (**4**).

2.1.3 Pressure transducer (5)

It is fitted on the overcenter valve of the lifting cylinder to sense the pressure inside the bottom side of the lifting cylinder itself. Its output is a variable electric signal, proportional to the pressure.

2.1.4 Reset micro-switch (boom lowering) (6)

It is activated by a cam fixed on the control lever of the lifting function, when the boom lowering function is operated, and resets the excessive load locking alarm from the load cell when lowering the boom.
The micro-switch contact is N.O. (normally open) when the control lever is in neutral position.

2.1.5 Dump solenoid valve (Pict. 2)

Its cartridge (**7**) is screwed in a proper housing of the valve bank, and connects the P port with the T port, when the solenoid (**8**) is not energized, so that the oil is not available for the crane functions. When the solenoid is energized, the oil flow from P port is available for the crane functions. In conditions of load cell overload locking alarm, the solenoid is not energized, and dumps the oil flow to tank, so that all the crane functions are locked except for the boom lowering.

2.1.6 Emergency manual override (9, pict. 2)

The dump solenoid valve cartridge is equipped with a manual override, the knurled knob is secured, against tampering, with a lead seal.
Its purpose is to by-pass the safety system, when a failure occurs, and it's not possible to exit from the error alarm.
The by-pass is enabled by screwing the knurled knob completely in, after the lead seal has been removed.
In this condition, the crane is to be operated to put down the load and to be brought into transport position, in order to reach the closest assistance workshop.

ATTENTION ⚠

The manual by-pass override must be moved only in an emergency. It by-passes the safety system and great attention must be paid by the operator whilst moving the crane in these conditions. Its purpose is solely meant to enable the crane to be stowed in the transport position, reaching the closest authorized workshop and having the safety system checked, repaired and sealed again.

2.1.7 Controls cover (10, pict. 2)

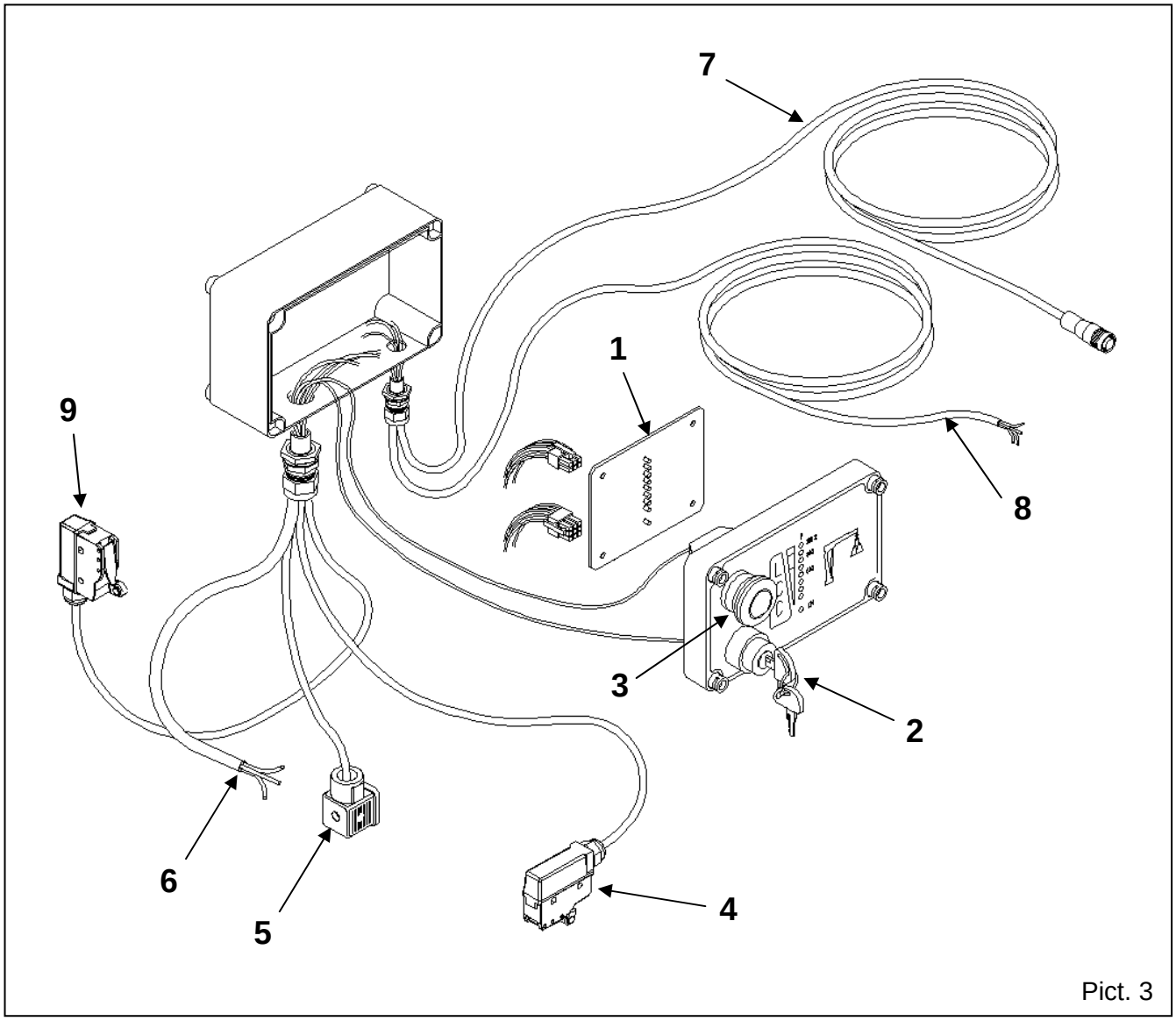
Its purpose is to protect the control system components, and to prevent the control levers being accidentally operated; when it's necessary to access the components of the control system, it has to be removed.

2.1.8 Centralized micro-switch (11, pict. 2)

This micro-switch is present on electrohydraulic cranes without remote control only. In this case, it is activated by carrying out any of the functions. The activation of this micro-switch brings the positive voltage supply directly to the yellow/green wire. In this case, when activating any of the functions, the motor pump starts.
The micro-switch contact is N.O. (normally open) when the control lever is in neutral position.

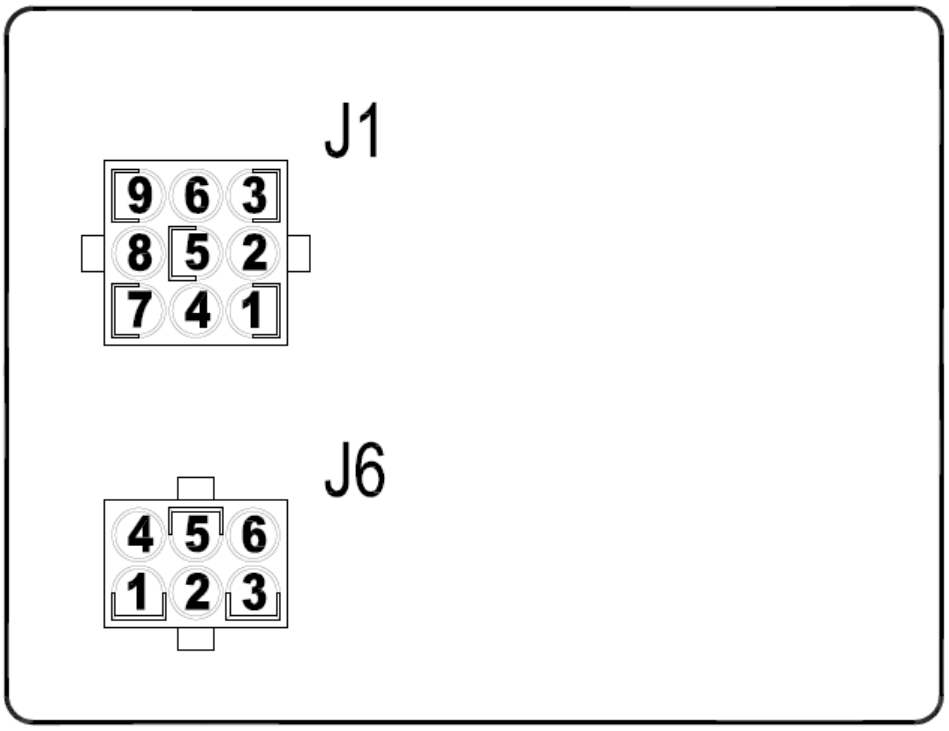
2.2 Components of the control unit box (Pict. 3)

1) Electronic card
2) ON/OFF removable key
3) Red emergency stop button
4) Reset micro-switch
5) Dump valve solenoid connector
6) Supply cable
7) Cable for pressure transducer
8) Cable for load cell
9) Centralized micro-switch (“E” version only)



Pict. 3

3 Calibrations (Pict.4)



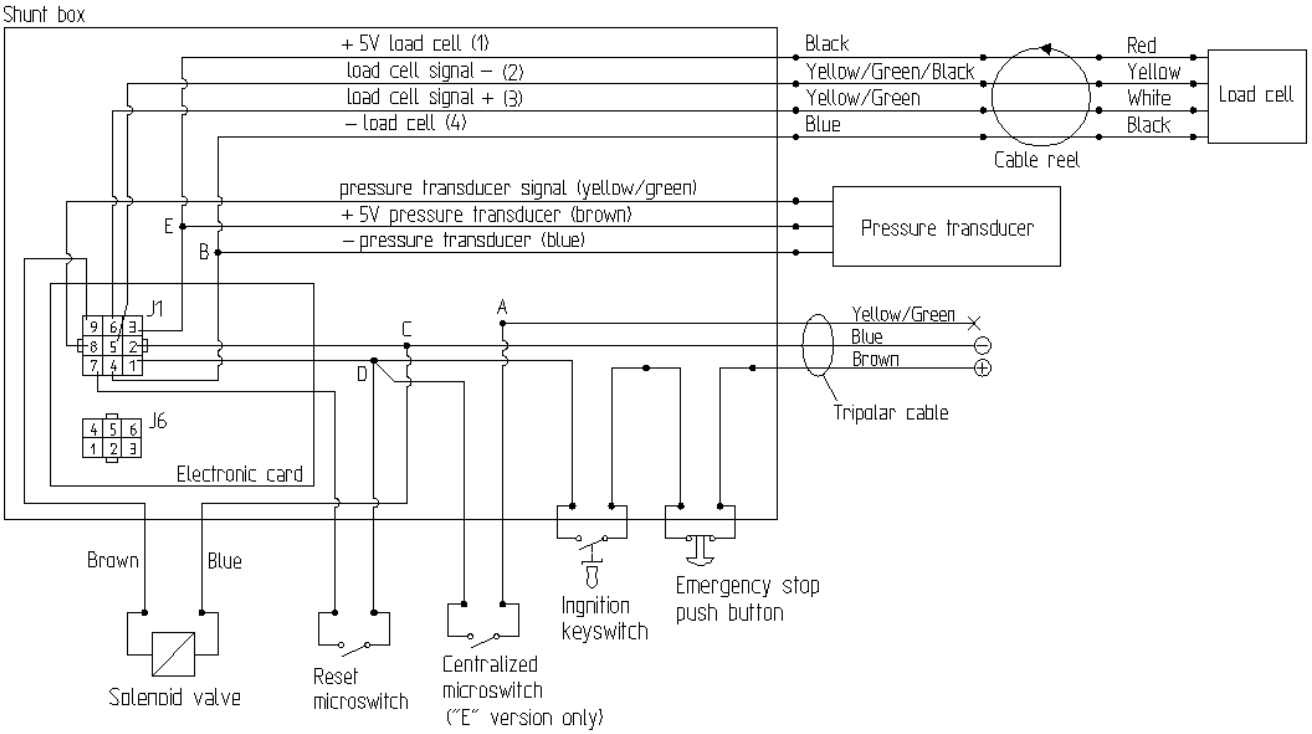
Pict. 4

3.1 Calibration for the intervention of the pressure transducer

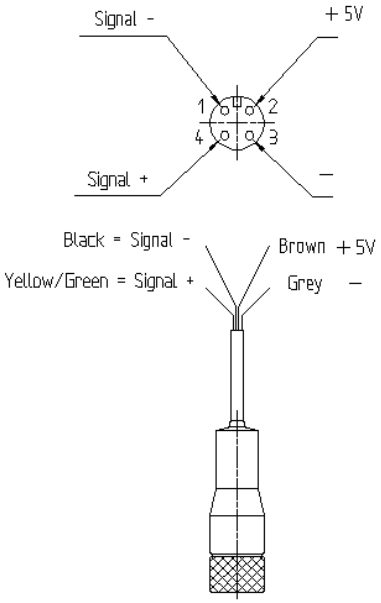
- When the system is ON, bring the nominal load at the maximum outreach.
- Bridge J6,6 and J6,5 (terminals 6 and 5 of J6) for at least one second.
- Check that all the LEDs are lit up.
- Retract the extensions, checking that the LEDs turn off one by one.

3.2 Calibration for the intervention of the load cell

- When the system is ON, activate the reset micro-switch (boom lowering).
- With a load of 990 or 1000 kg at the hook, and with the reset micro-switch activated, bridge J6,6 and J6,5 for at least one second.
- Release the reset micro-switch.
- Check that all the LEDs blink simultaneously.

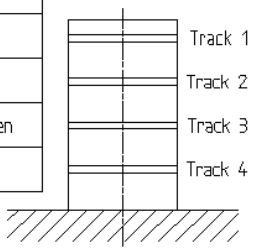


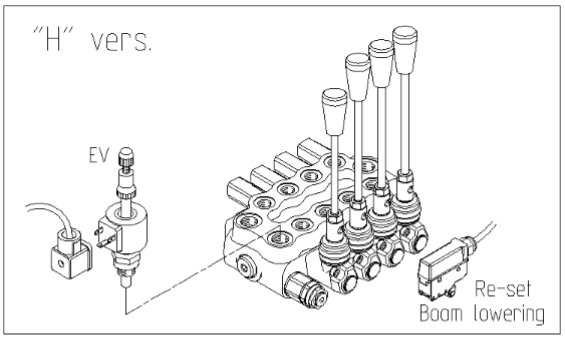
M12x1 – 4 poles female connector, for load cell, connected to the end of the cable reel cable

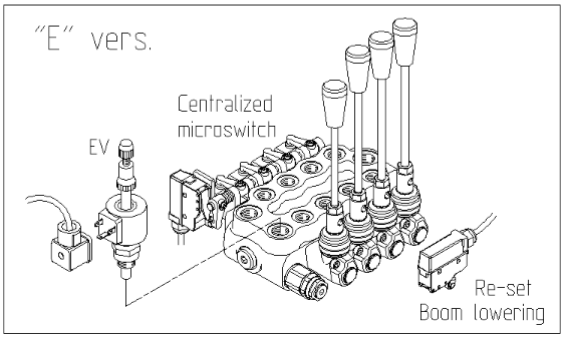


Connection for load cell, from shunt box to cable reel tracks

Quadripolar cable wires from shunt box	Connection wires on cable reel	Signals	Quadripolar cable wires of cable reel
1	Black (1)	+ 5V	Brown
4	Blue (4)	–	Grey
3	Yellow/Green (3)	Signal +	Yellow/Green
2	Yellow/Green/Black (2)	Signal –	Black







Pict. 5

5 Diagnostic information

5.1 Technical data

Permitted supply voltage range: 9 to 33 V
Permitted working temperature range: -40 to +70°C
Current absorption of the whole system (electronic card + pressure transducer + load cell + solenoid valve):

- 1.57 A (12V)
- 0.82 A (24V)

The system complies with:

EN 61000-6-2
EN 61000-6-3

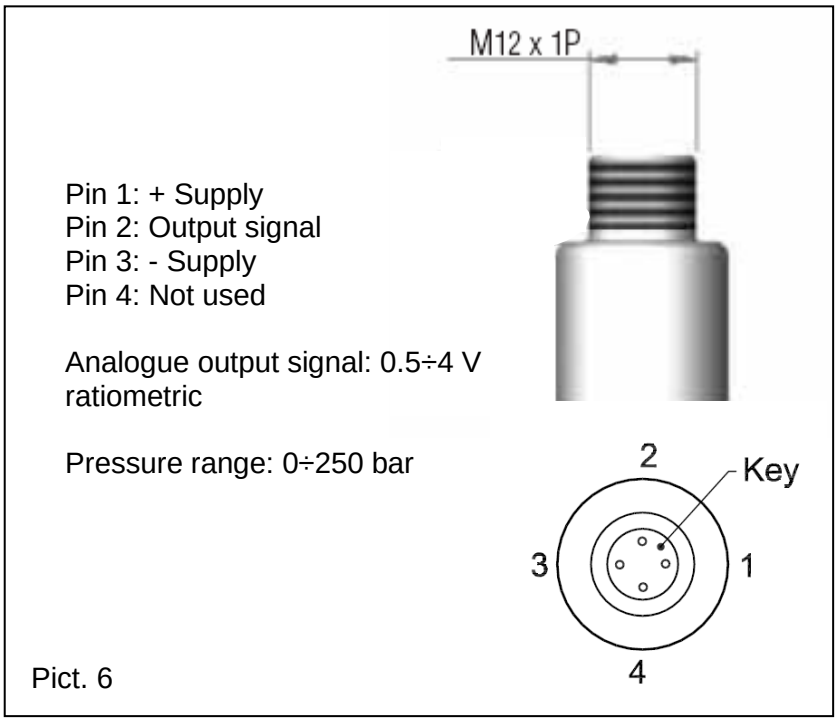
The system complies with Category B according to EN 954-1

5.2 Protections of the system

The electronic card is protected against:

- polarity inversion
- disconnection or shorting of the pressure transducer wires

5.3 Testing the transducer (Part number LM.1.015)



Pict. 6

5.3.1 Explanation of the ratiometric output signal

The supply voltage has to be 5V. The ratiometric output signal is to be calculated as a percentage of 5V supply voltage. The ratiometric percentage range is 10% ÷ 80%. Therefore, the output signal range is 0.5V ÷ 4V.

5.3.2 Test procedure

Supply the transducer with a voltage of 5 V, and measure the voltage on the output signal line. Theoretically, the current values to be read should be **0.5 V** at **0 bar** and **4 V** at **250 bar**. The tolerance is ±0.5% of the analogue output signal range, that is 3.5V (4-0.5), therefore 0.0175 V. This means that, at 0 bar, it can read a voltage from 0.4825 V to 0.5175 V, while at 250 bar, will read a voltage from 3.9825 V to 4.0175 V. Should it be necessary to know what the voltage value should read at 100 bar, it's necessary to write the proportion 3.5/250=x/100, which result is x= 3.5*100/250. The voltage value is **V = 0.5 + x**.

Example table:

Pressure	Voltage DC		
	Nominal	min.	max.
Bar	V	V	V
0	0.5	0.4825	0.5175
50	1.2	1.1825	1.2175
100	1.9	1.8825	1.9175
150	2.6	2.5825	2.6175
200	3.3	3.2825	3.3175
250	4	3.9825	4.0175

5.4 Testing the load cell

With a multi-meter (scale in mV), measure the voltage between the positive and negative lines of the load cell signal. The voltage shall variate from 0 mV at 0 kg to 4.5 mV at the maximum allowed load.
IMPORTANT:
The load cell has to be correctly oriented, with the arrow downwards (same direction of the load) as represented in picture 7.

Pict. 7

5.5 LED error messages: Explanations and fault finding

5.5.1 LED DL1 flashing

***This error code has been removed starting from electronic card serial number 6041939 (manufactured by B.P.E. on 11th July 2013).**
In the cards manufactured before, the error concerns the load cell only, and indicates that the voltage output signal coming from the sensor is below the minimum allowed from its working range. Since for the load cell, the lower value of the working range is 0 mV, this error code can only take place if the voltage output signal from the load cell is negative. This should theoretically happen when the load cell senses a significant load when the direction is opposite from the one indicated by the arrow represented on the load cell pin (Pict. 7).
But, in practice, most commonly, the error code comes up together with error code DL7 flashing, if the connection with the load cell is interrupted.
Since the calibration of a zero point with a load applied (even if small) is not foreseen for the application of this load cell on the Maxilift cranes, this error code is completely unuseful. This is the reason why the error code has been removed.

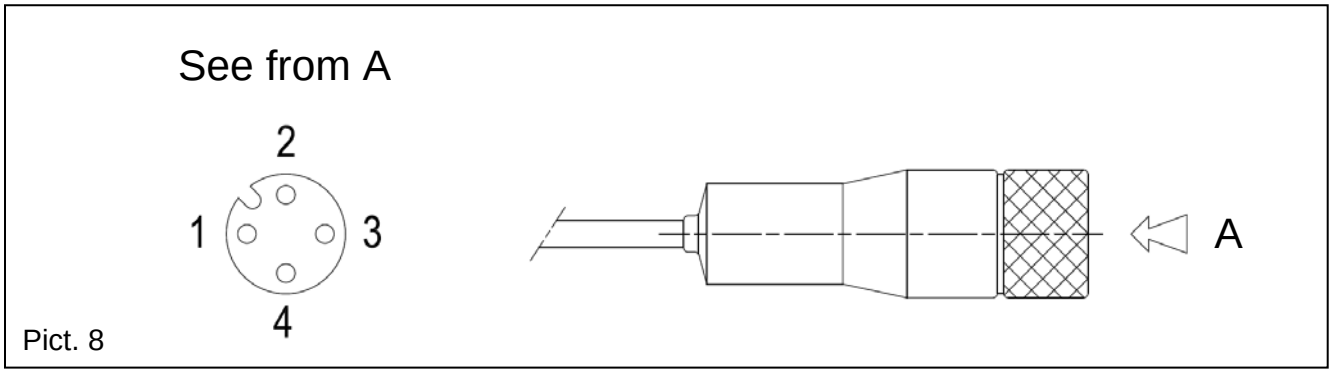
5.5.2 LED DL8 flashing

It indicates an error on the pressure transducer or its wiring that could be due to:

- Signal from pressure transducer not correct (check the part number and the signal type of the pressure transducer, first – see 5.2)
- Signal from pressure transducer missing
- Pressure transducer not supplied

Check first that the cable-connector is well tightened to the pressure transducer. If yes, check, at first sight, if the cable from the pressure transducer up to the protection sheath, towards the control unit box, is not damaged externally. Check also that the pressure transducer is not damaged externally. If all looks in good condition, proceed as follows.

- Disconnect the cable from the pressure transducer. With the LLC connected to the battery, measure the voltage on pin 1, inside the connector of the cable (Pict. 8). The voltage should be around 5 V.
- Check continuity between the minus on the battery and the pin 3.
- If one of these two measures is not OK, there are the following possible situations: faulty connector; cable interrupted inside somewhere; faulty electronic card.
  At this point, it's necessary to open the control unit box and check continuity between pin 1 and relevant brown wire on junction E, or between pin 3 and relevant blue wire on junction B, depending on which line is interrupted.
- If, instead, the two measures are OK, it's necessary to open the control unit box and check continuity between pin 2 and the relevant yellow/green wire on J1,8 (this last, after having the connector J1 disconnected from its counterpart on the card).
- If also on this line the continuity is OK, then the cable is OK, and problem can be: pressure transducer connector faulty; faulty pressure transducer; J1,8 faulty on the counterpart on the card. First try to clean the pins of transducer and of J1,8 on the card. If it doesn't solve, test the pressure transducer with a separate cable, like explained in paragraph 5.2. If the transducer is OK, replace the card.



Pict. 8

5.5.3 LED DL7 flashing

Check first that all the connectors on the connection wiring to the load cell are well tightened. If yes, check, at first sight, if the cables from the load cell to the cable reel, and from the cable reel to the protection sheath towards the control unit box are not damaged externally. If all looks in good condition, proceed as follows (Ref. Pict 5).

- With the LLC connected to the battery, disconnect the cable from the load cell, and measure the voltage on voltage positive supply line, on pin 2 of the connector at the end of the cable itself (Pict. 5). The voltage should be around 5 V.
- Check continuity between the minus on the battery and the negative supply line of the load cell, on pin 3 of the above mentioned connector.
- If one of these two measures is not OK, go on checking continuity of the interrupted line. Start opening the cable reel. If continuity is still OK, then open the control unit box, in order to complete the check, up to connector J1 on the card.
- If, instead, the two measures are OK, check the continuity on the positive and negative lines of the load cell signal. Open the cable reel before, and only if necessary, the control unit box. If the continuity is OK from connector J1 up to the end of the cable reel cable, the problem can be: faulty load cell (or its short cable) (test with a separate cable, as described at paragraph 5.3); faulty electronic card.

5.5.4 LED DL8 lit up

One of the two calibrations has not been done correctly. Perform the calibration by following carefully the instructions at chapter 3.

5.5.5 LEDs from DL1 to DL8 flashing simultaneously

Load cell overload (see chapter 1). If the alarm takes place with a load too much different from 990 kg or 1000 kg, it can be that the calibration has been modified. Try first to perform a new calibration (paragraph 3.2). If it doesn't solve, test the load cell as described at paragraph 5.3. If it doesn't solve, change the card.